INTERNATIONAL COOPERATION AND COMPETITION IN SPACE

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SPACE SCIENCE AND APPLICATIONS

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INTERNATIONAL COOPERATION AND COMPETITION IN SPACE

WEDNESDAY, JULY 25, 1984

House of Representatives,
Committee on Science and Technology,
Subcommittee on Space Science and Applications,
Washington, DC.

The subcommittee met, pursuant to call, at 9:35 a.m., in room 2325, Rayburn House Office Building, Hon. Harold L. Volkmer (chairman of the subcommittee) presiding.

Mr. **Volkmer**. The Subcommittee on Space Science and Applications will come to order.

Today, the subcommittee meets to survey the status of and prospects for international cooperation and competition in space.

The place and meaning of the international dimension of our space program is changing rapidly as we see sophisticated space capabilities developed in other nations, expanding both opportunities and challenges for cooperation and competition in space. The success of our future U.S. program may, in large part, very well depend on the strength and resilience of these international relationships.

The subcommittee is also pleased today to unveil the publication of a report of the Office of Technology Assessment on "International Cooperation and Competition in Civilian Space Activities."

The breadth and scope of issues the report surveys will provide useful insight to the Congress on U.S. cooperative and competitive relationships in space with other nations. Its release now is particularly timely as the United States embarks on the development of a permanently manned space station with our international partners. The OTA study will be a useful reference as we enter a new era of international cooperative activity in space.

I am pleased to welcome today Dr. Ray Williamson, Project Director of the OTA Study. He is accompanied by Peter Sharfman, Program Manager, International Security and Science Program at OTA.

We also welcome three administration witnesses, who will provide us with the different agency perspectives on our international relationships in space. We welcome Ken Pedersen, Director of the International Affairs Division at NASA, Mr. Otho Eskin, Director of the Office of Advanced Technology, Bureau of Oceans and International Environmental and Scientific Affairs, Department of State, and John McElroy, Assistant Administrator for Environmental Satellite, Data, and Information Services, National Oceanic and Atmospheric Administration.

Prior to proceeding with the witnesses, I will recognize the gentleman from New Mexico for a statement.

Mr. **Lujan**. Thank you, Mr. Chairman.

In a sense, the U.S. space program was born because of international competition. The launch of Sputnik I in 1957 resulted in a steppedup American space program. The effect of the competition continued because the first man in space was Cosmonaut Yuri Gagarin.

Shortly after that, Alan Shepard was the first U.S. astronaut and the United States intensified efforts to take the lead in space. We took the lead when we put several men on the Moon. Our country has maintained a leadership role in space technology and achievement, but clearly international competition had a strong role in the early history of our space program.

On the other hand, one of the earliest things recognized in the U.S. space program was the need for international cooperation. The charter that established NASA in 1958 included the purpose to foster international cooperation. There has been a long tradition of international cooperation, especially on space science programs. We had just about had a monopoly on cooperative international space programs.

As the space program has evolved, the nature of both the competition and the cooperation has changed. We now have economic competition such as with the Arianne in transportation and with SPOT in remote sensing; the U.S. space program is much more international in nature than it was 25 years ago or even just a few years ago. As we look toward developing the Space Station and toward further developing the commercial uses of space, the international aspects of the space program will be taking a quantum leap.

We can already see several policy issues emerging. Shuttle pricing policy is an obvious issue of international competition. The development of the space station will involve both aspects of competition and cooperation. The high international visibility of our space program makes it an important aspect of our foreign policy. This hearing should help us better understand the emerging policy issues.

I hope to discuss with our witnesses today what mechanisms exist and what mechanisms might be needed to resolve international program issues.

Thank you very much, Mr. Chairman.

Mr. **Volkmer**. Thank you, Mr. Lujan.

At this time, I would ask Mr.—Dr. Ray Williamson and Dr. Peter Sharfman to come to the witness table and we will proceed.

Mr. **Nelson**. Mr. Chairman.

Mr. **Volkmer**. Yes.

Mr. **Nelson**. While he is proceeding, could I ask unanimous consent that WCPX-TV be allowed to take some photographs of the committee in session?

Mr. **Volkmer**. Without objection, it will be so ordered.

Dr. Williamson, your statement will be made a part of the record and you may either review it in full or summarize, however you so desire. You may now proceed.

STATEMENT OF DR. RAY A. WILLIAMSON, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT, ACCOMPANIED BY DR. PETER SHARFMAN, PROGRAM MANAGER, INTERNATIONAL SECURITY AND SCIENCE PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. **Williamson**. Thank you, Mr. Chairman.

Mr. Chairman, I am pleased to report today on the major findings of the OTA report, "International Cooperation and Competition in Civilian Space Activities."

This project was carried out as part of OTA's International Security and Commerce Program. With me is Dr. Peter Sharfman, the Program Manager, who will be available to answer questions on some of the broad international issues, should they arise.

In the audience are OTA staff members Dr. Douglas Adkins, Mr. Richard DalBello, and Dr. Gordon Law, each of whom made major contributions to the report. They will be available later to answer specific questions, should it be appropriate.

The completed report is now in the publishing process and should be back from the printers by early or mid-September.

In my oral statement I will summarize some of our most important conclusions concerning international cooperation and competition in space, drawing on specific illustrative examples from space science and space applications.

In the past decade, we have seen Western Europe and Japan develop a strong presence in space. Their Government programs and their industry have now placed them in a competitive position with respect to the United States. Because of their growing capabilities, these industrialized countries are also now increasingly valuable partners for cooperative activities.

In addition, several newly industrialized countries have developed small space programs. At the same time, major U.S. firms have expanded their interest and investment in the commercial applications of outer space. All of these developments affect the ways that nations now cooperate in space.

These changes in the fabric of civilian space activities, which have political, economic, and technical ramifications, rise the following interrelated concerns for the Congress:

First, the state of U.S. competitiveness in space technologies.

Second, the role of the U.S. private sector in space.

Third, access of U.S. firms to international markets.

And, fourth, the efficacy of U.S. participation in international cooperative space projects and international organizations.

I will begin by talking about our competitiveness in space technologies. Although the United States still leads in space research and development and, where it has open access to markets, also in technology sales, Western Europe and Japan are now marketing space-related goods and services in direct competition with the United States.

The European Space Agency's Arianne expendable launcher is the most prominent example of European competitiveness. Arianne not only serves most of Europe's launch needs, it competes both with the shuttle and with privately owned U.S. expendable launchers for U.S. commercial and third-country launch services.

Further, France expects to launch its SPOT remote-sensing satellite about this time next year. Data will be sold through the French firm, Spotimage. In a preliminary effort, its American subsidiary, SPOT Image Corp., has just completed what appears to be a successful campaign to sell simulated satellite data from selected areas of the United States taken by aircraft.

By the start of the next decade, Canada, the European Space Agency, and Japan, expect to deploy both land and ocean as well as meteorological remote-sensing systems.

In contrast, although the United States expects to continue testing various remote-sensing instruments on the shuttle, it has no plans to fly any civilian ocean remote sensing systems this decade.

Now, the role of the U.S. private sector. Except for satellite communications, in which U.S. private investment has long dominated, significant barriers of high cost, and high technological, and economic risk continue to deter new investment.

Put simply, private firms, to date, judge that it still costs too much to place humans and machines in space compared to the benefits they might expect. If the United States is to retain its international competitive position in space, the Government will have to find ways to involve the private sector more deeply in space investment, and to avoid competing with it.

For example, although the administration seeks to encourage free market competition, the current pricing policy for the Government-operated shuttle makes it difficult for the private sector to compete. The shuttle pricing policy was developed to encourage users to transfer their business from the trusted, expendable launchers, then operated by the Government, to the shuttle.

Today, we have a complex issue before us. If prices for the shuttle services are high, potential shuttle users will be deterred from using the shuttle. Low prices, though they enable NASA to compete effectively with Ariannespace, at the same time also deter private providers of launch services.

The testing of manufacturing processes in space is one area in which inexpensive access to space via the shuttle could be especially effective in promoting the private development of space. Agreements, such as the NASA joint endeavor agreement, which allows private firms relatively inexpensive access to the shuttle, would greatly facilitate the manufacture of certain high-value materials in space should these processes otherwise proves—prove cost effective.

Another example, recently the Congress took a major step toward opening up one avenue to the private sector by passing the Land Remote-Sensing Commercialization Act of 1984, a bill in which this committee was the lead committee. This would establish the means to promote the use of remotely sensed data from space.

Now, lack of a dependable supply of such data continues to deter the growth of the domestic and international data market. I might add there that the international data market could be eventually the largest market for a private concern.

Consistent marketing efforts by private industry, and a properly designed private satellite system, could go a long way toward building the volume of data sales necessary to provide, promote—support, sorry—a private system. However, building a substantial market for remote sensing data will likely require a sizable subsidy for a period of years. It will also depend directly on a strong value-added industry capable to process and manipulate data.

Now I will turn to a third concern: the access of U.S. firms to international markets.

The largest substantially open market for sales of space-related equipment is the domestic U.S. market. The European market is protected, and while there has been progress in opening up the Japanese markets, such progress has been slow and uncertain.

Where open competition exists, in the United States and some Third World markets—in other words, where price, quality, and assured delivery are the primary considerations of a sale—the United States continues to dominate the market.

In satellite-communications services, international competition is almost nonexistent. But changes brought by new technology, increasing numbers of satellite communications service providers, and types of services, prompts reconsideration of the U.S. role in the international communications industry.

The United States, for instance, must decide soon whether it wishes to continue its past support of Intelsat as the only provider of intercontinental satellite communications facilities or whether it will permit U.S. firms to launch independent and/or competitive satellites. The Government must also decide how vigorously to support U.S. firms seeking access to protected international markets in general.

Now, our fourth concern: international cooperation.

The United States cooperates with other nations in two distinct areas: international projects and international multilateral organizations. My comments will focus on international projects. The OTA "Technical Memorandum on UNISPACE '82," right here [indicating], which was prepared for this subcommittee as part of this study, discusses U.S. participation in international organizations.

Cooperation between countries in space science and in some applications continues to be a source of cultural, economic, political, and social benefits. It's a good thing, in other words. Reducing U.S. costs will continue, however, to be the major driving force behind large cooperative projects.

The United States cooperates with both industrialized and developing nations. If we wish to reap the full economic and political benefits of our space program, our cooperative applications programs must continue to involve the developing countries, especially because they are becoming a significant market for space-related goods and services.

In the near future, the largest single area in which we may cooperate with the industrialized countries is in building and using permanent space infrastructure, including a so-called space station.

Possible modes for such cooperation are detailed in another OTA report, "Civil Space Stations," which will be released this September. Although I cannot present findings of that study, I can offer a few general observations from our study concerning cooperative space activities, and these could be applied to considerations of a space station.

First, one of the primary concerns in developing joint technology projects with other countries has been the possibility of inadvertently transferring commercially useful technology to an economic competitor. Although in the past this has been cast as a problem primarily for the United States, our potential partners are now rightfully concerned about transferring certain technology to us. Thus, it may be in the best interests of all parties to keep the national contributions to a project as free of overlap as possible.

On the other hand, part of the terms of a cooperative venture could be the explicit sharing of certain technologies among partners in a truly co-op-collaborative venture.

And, second, our international partners have complained that in the past they have received less payoff for their efforts than they expected. For example, the Europeans put more than $1 billion into developing the spacelab module, but apart from the experience gained from building it, they derive little more tangible value from using spacelab than does any other potential foreign user today. Because they are now technologically capable, they are now in a position to bargain with the United States for their part of any cooperative venture. And I think we begin to see that in various statements from the Europeans on possible space station cooperation.

We can also see the altered roles of the United States, and Europe, and Japan in the international Halley watch, where the United States has assumed a supporting, rather than a leading part, based on a recognition that the United States need no longer rely solely on unilateral efforts to maintain momentum in space science generally.

In closing, I'd like to observe that the U.S. space program has broadened markedly in the last 26 years. Since 1958, what this Nation sought to accomplish in space was achieved by NASA within the broad principles and goals of the National Aeronautics and Space Act. With the increase in foreign and commercial activities, however, we've seen other Government agencies such as the Departments of Agriculture, Commerce, Interior, and State, and the Federal Communications Commission, and the private sector now play a greater role in setting our national agenda in space.

This circumstance makes the oversight responsibilities of this subcommittee more difficult because the process of providing for and maintaining U.S. leadership in space has become more complex.

Strengthening U.S. competition with other space-capable nations, or improving our ability to cooperate effectively, will require careful attention to the means of coordinating the activities of all the Federal agencies with each other and with those of the private sector.

And, finally, it is obvious that the United States needs a clear sense of its purpose in space. The recently mandated National Commission on Space can provide the necessary public forum for analyzing the needs of the Nation with respect to space. However, it will now be important for the Commission to specify the relationship of future goals and objectives in space to other national goals related to foreign policy and international trade.

Mr. Chairman, that completes my statement to the subcommittee. Dr. Sharfman and I would be pleased to answer questions.

[The prepared statement of Mr. Williamson is the Summary Report "International Cooperation and Competition in Civilian Space Activities," included as Appendix I.]

Mr. VOLKMER. Thank you very much. At this time I'll recognize the gentleman from New Mexico.

Mr. LUJAN. Thank you, Mr. Chairman.

One of the things we are continually concerned with in the committee, and I guess through the entire Government, is pricing policy of the shuttle. We are, of course, very dedicated to the fact that there has to be subsidies to things that are shuttle dependent, such as materials processing, scientific matters, and those kinds of things. Yet, we look at other things that can be launched by ELV's and we are kind of caught in the middle about whether we just allow the market to decide without manipulating the cost on the shuttle to compete with them. And yet again, as you mentioned, we don't want to leave it to Arianne.

What are your thoughts about shuttle pricing? I know you mentioned that we compete with private enterprise—and God forbid that you—that government compete with private enterprise. And that's a true belief on my part. Yet, we're caught on the horns of this dilemma.

What, give me some of your thoughts.

Mr. WILLIAMSON. Well, I can try to—to illuminate, if possible, the—the complexities we find ourselves in.

Mr. LUJAN. How about the solutions?

Mr. WILLIAMSON. Well, maybe that'll help us get to some solutions. I don't think there's an easy solution to the question or we would have—we would have said so in our report. Let me just spell out a little bit part of what was in my oral testimony. And that is, if the prices are high, as you point out, we may prevent some firms who might be interested, say, in materials processing, manufacturing processes in space from using the shuttle for that purpose.

We also make, obviously, would make the communications satellites transportation to geosynchronous orbit possibly more expensive if we were to raise prices on the shuttle. On the other hand, the communications satellites have the option of using expendable launchers. By and large, the materials processing people don't have that option.

So one of the big advantages of the shuttle is to be able to take something up, leave it for a while, and bring it back. So the raising prices would have an impact in the area of any kind of service where the returnability of the shuttle is important. So that's the one side of the coin.

On the other side of the coin, we do have a policy that is set to promote the privatization and commercialization, if you will, of ELV's, and, they are finding it hard to compete under the—under the present shuttle price. So that's partly to repeat the dilemma.

Our own thinking about it is if the shuttle prices go up, that in time, if not right away, the Ariane prices will go up as well. After all, they are also being subsidized—to what extent it's a little difficult to figure out.

Mr. LUJAN. If I might ask you, do we know our own figures in that respect? Do we know what kind of returns—does OTA get into that?—what kind of returns NASA does get by charging clients versus the total cost? What I'm getting at, it may be very insignificant, the rate of return to NASA. Kind of like, if you take the estate tax, brings in about $5 billion out of $600 billion, or whatever total gross is—very insignificant.

Mr. WILLIAMSON. Well, it's a little difficult to—to say exactly what—how much the shuttle is subsidized and versus how much they charge commercial customers. The commercial charge in 1984 dollars is about—if I remember correctly—about $70 million per shuttle bay.

Mr. LUJAN. Seventy million out of the $8 billion——

Mr. WILLIAMSON. And the agency has said that it cost between $250 and $350 million per flight for the shuttle, so——

Mr. LUJAN. Well, I was—I was thinking in terms of how much do we bring in. You say——

Mr. WILLIAMSON. I see.

Mr. LUJAN. About $70 billion. Compared to the entire NASA budget it's nothing.

Mr. WILLIAMSON. Yeah.

Mr. LUJAN. So we do—it's—the whole pricing thing might not be all that important if we are just talking about $70 million out of an $8 billion——

Mr. SHARFMAN. If I might comment for a moment. I don't believe it would be possible to figure out what an unsubsidized price for a shuttle launch would be, because if you were dealing with a private enterprise funded initially be investors in there to make money, they would be wanting to recover money that had been spent on research and development at the beginning of time.

Mr. LUJAN. Leaving all of that aside, and I'm just talking about, you know, it cost about $250 to $300 million to get it up there and——

Mr. SHARFMAN. NASA's present philosophy, as we understand it, is to assume that the shuttle will fly anyway; that the primary purpose of the shuttle is to carry Government cargos, that it is needed to carry Government cargos, and that it's flying on a regular schedule with predictable number of flights into the years ahead, is an important value to the Government. And they rule out the possibility for their calculations, that if ELV's were more widely used there might be fewer shuttle launches. So they calculate their costs on the basis that the shuttle is flying anyway.

Now, how much extra does a given shuttle flight that's taking place anyway cost if you're going to carry private cargo as well? And they set their pricing to recover those costs, and they do. But they don't take into account the possibility that if they weren't carrying private cargos at all, the Government cargos might over time be shoe-horned into fewer flights, which would reduce the out-of-pocket costs.

Mr. LUJAN. Yeah, but that's kinda' like saying, I'm going to drive from here to Albuquerque and maybe, you know, if I take someone with me, what's the extra cost in the car? And it's probably negligible, and the $70 million is probably——

Mr. **WILLIAMSON**. That's correct, that's right.

Mr. **LUJAN**. A windfall—if Harold decided to share the gasoline with me to go to Albuquerque.

Mr. **SHARFMAN**. Right. It would be quite different if you were going to Albuquerque and you said, I figure that the total cost for driving my car is 25 cents a mile, so I want you to pay 12½ cents a mile all the way to Albuquerque. That would be a different kind of calculation, and that's not what you're—that's not what NASA has been doing.

But there is a basic problem arising from the fact that Ariane is subsidized. We don't know exactly how much, you have problems calculating it there as well. One would ideally like a situation for the point of view of the U.S.-ELV industry, you would like a situation in which the shuttle cost less than Ariane but more than the ELV's. That requires that our own commercial ELV's be able to undersell Ariane which is subsidized by the French taxpayer, and that's not going to happen.

Mr. **LUJAN**. We could send our own companies up for free, and they wouldn't make that much difference, I don't think.

Mr. **SHARFMAN**. No; but in order if the shuttle prices were raised high enough so that our own private sector could undersell the shuttle for launching communicap—communications satellites, then we would also have a situation in which Ariane could undersell the shuttle for launching communication satellites, there would be competition between U.S. private ELV's and French Government-subsidized ELV's, and I would conjecture that that would bring the U.S. private sector in here asking for subsidies to match the French subsidies.

Mr. **LUJAN**. I understand. Can we get onto another subject which perhaps is just as important in the whole area of international commerce and cooperation and all of that?

Did you sense when you were making this study, that maybe NASA and the Department of Commerce might be at cross-purposes, or at least not seeing eye-to-eye on the direction that we ought to move, or one being a stumbling block or another, however minor or major it may be?

Mr. **WILLIAMSON**. Well, I think that's always a possibility when there is a changing situation as we see happening in space, and different government agencies begin to develop expertise and some priorities in an area that has been dominated by another agency. But this is not something that we focused on in our study very much, as a matter of fact.

Mr. **LUJAN**. I was wondering whether we need to address that legislatively if, you know, there's some turf problems that we might be able to——

Mr. **WILLIAMSON**. Well, where we suggest that could be addressed such questions if they arise, could be addressed legislatively is in providing legislation to designate a lead agency for particular technologies. Today, we see, of course, Commerce Department with NOAA, as part of the Commerce Department, in charge of our Metsat program and—and now our Landsat program. And it's that sort of thing that could be done; the sort of thing that is now the case with the Department of Transportation, for instance, being in charge.

Now, I think there are inevitable frictions as turf changes in that.

Mr. **Lujan**. Thank you, Mr. Williamson.

Mr. **Volkmer**. The gentleman from Florida.

Mr. **Nelson**. Thank you, Mr. Chairman.

A minute ago you said that NASA had a pretty fixed idea in its mind of what the pricing was going to be and how and what the number of payloads were going to be. Would you elaborate on that, Dr. Sharfman?

Mr. **Sharfman**. Well, NASA has developed a schedule for the shuttle that runs several years into the future. Schedules change when things go wrong and with the flexibility there, I wouldn't want to accuse them of being rigid—I hope I wasn't—I didn't mistate——

Mr. **Nelson**. No.

Mr. **Sharfman**. But people have to plan. If you are going to have private sector payloads on the shuttle, they have to decide years ahead what the payload's going to be, they have to—it has to be built. That requires a launch schedule, so that they can be aiming to a point when it would be launched. And if it's going to be any sort of commercial venture, they have to know what the price is going to be. So NASA—they are very strong reasons for NASA to make shuttle users aware several years in advance when there will be flights and what the cost would be of putting a payload on that flight.

At the same time, NASA, quite properly, doesn't say that this will apply for all time; they schedule a few years ahead, and the presumption is that they will continue to project ahead. And the prices that they have projected ahead for the next few years are calculated on the assumption that the schedule will stay as it is regardless of how much there is in the way of private payloads. If there is a tremendous amount of private payloads, they will just have to wait in line. If there aren't that many, a shuttle might go up only partially full, but the shuttles will fly regardless.

Mr. **Nelson**. We have several different elements focusing in on this question that we are discussing today, international cooperation and competition. One is, and you are aware of, Mr. Beggs' considerable agitation over the fact that the Air Force is now proposing to pull off a couple of payloads a year and establish their own ELV. So there's the question of what is the degree of the future use of the shuttle by the Defense Department?

When the declaration of policy was set down in 1972 by the President, it was to develop the space transportation system. And now we see that that's not really the case. We see that the Air Force is going to want to have their own unmanned vehicle, be it a juiced up Titan, or be it a shuttle derived kind of technology.

At the same time, hovering over this whole thing is the question of how many orbiters are we going to have? What capability are we going to have? How much down time is there going to be if there is some repair that has to be made to an orbiter in the future?

And then all along with this is the pricing policy. We have a new declaration of intent and that is that we want to encourage American commercial space ventures through American ELVs, and not to undercut them. Now, with all of those different elements, can you all give us any specific direction as we try to understand this problem, as we try to encourage NASA, and as we try to assist NASA?

Mr. WILLIAMSON. I think one of the concerns that as I understand it, the Air Force has is the overall reliability, not of the shuttle itself but of the launch schedule, whether they can get a launch off when they need to get a launch off. That, by the way, is also the case for a communications satellite. Can the company put their new satellite up at the time they need it for expanding their—the services to their customers.

So there has been a great deal of concern about that lately. And that is another element in the whole debate, and part of the reason, at least, that the Air Force has proceeded along the lines it has proceeded.

The concern that we have, is that there in fact be a—a strong ability to launch payloads to orbit. And as we have said in an earlier report that one of the ways to do that is to have ELV's available either for expanded launches—expanded demand, or for backing up the shuttle if need be.

So, I'm not sure—as I understand it, the committee—the subcommittee is holding a set of hearings on the pricing policy coming up. And perhaps some of these issues can—will come up in that.

But I think it's a complex issue and it's something that what we've done is lay out all of the various issues. At this point it's not easy to see a very straightforward solution.

Let me suggest that if the shuttle prices were to go up somewhat, the, and there was some mechanism for supporting other private sector interests in space, such as, for example, the joint endeavor agreement—expanding the joint endeavor agreement—there might be some possibility of supporting the private ELV business. And that could, it seems to me, take some of the pressure off of the Air Force, if there was a strong expandable launch vehicle business going.

Mr. NELSON. Let me ask you this. I'm not sure that I really understand this. But, as a Member of Congress that came here 6 years ago and lobbied awfully hard to get some supplemental appropriations—specifically, in 1 year $185 million and in another year $350 million, in order to get the shuttle to where it needed to be. And the way that we sold that was saying that we're going to have a reasonable system that is going to be efficient and economical.

All right. Now, if that's the predicate on which we built the space shuttle system, what is your opinion as to whether or not we are undermining that by suddenly encouraging this and that elsewhere, whether it be Defense, whether it be commercial, et cetera, et cetera? How do you see that fitting into the whole picture?

Mr. WILLIAMSON. I don't think it needs to undermine that thrust. I would expect NASA to continue its development of shuttle and shuttle-derived vehicles regardless of what's happening, or could be happening within the private sector. We might take an example from the aeronautics industry, where NASA continues to help the industry develop new technologies at the same time that the industry itself is producing aircraft, and putting a lot of their own R&D money in.

So I think it's possible to have both. And essentially, my answer, I guess, is that we don't need to undercut the shuttle. We do have to be very careful, however. We were very optimistic about what the shuttle would provide in terms of price per pound orbit, and how quickly we could get the shuttle truly operational. Declaring it operational doesn't make it an operational bird.

Mr. **Sharfman**. If I might elaborate briefly on that point. The reusable transportation system has one set of exam, advan—one set of advantages deriving simply from the fact that it comes down as well as going up. And Congressman Lujan mentioned its relevance for materials processing in space—clearly if we move in the direction of a space station and a permanent man presence there, you have to have something like the shuttle.

The other advantage is that being reusable, it is cheaper than something that you throw away every time. That doesn't seem to be the case. The shuttle has cost a lot of money, the shuttle continues to cost a lot of money. ELV's have behind them more years of research, more years of experience, more years of little by little chopping away at unnecessary costs.

We could declare the shuttle cheaper simply by subsidizing the launches to such an extent that they would always be—the books would show that they were cheaper, but the money would still have to come from somewhere. Moreover, if the shuttle completely dominates the space transportation business, pressure will build up for additional orbiters. And it looks as though each additional orbiter that we buy will in the medium-term increase the cost of the space program to the taxpayer, one way or another.

Now, if you take the view that it's very important to maximize the speed with which the United States moves out into space and does more and more things with space and in space, then that money could be said to be well spent.

And, you know, you could make the analogy that the transcontinental railroads cost the taxpayers a lot but it all came back as the West was opened up and developed.

And, similarly, if you take a very optimistic view about the economic advantages to be derived from having a lot of involvement in space, then it's a good investment to get there as far as you can and make it as cheap as possible, for example, for the private sector to get a payload on the shuttle.

But you can't simply say that there's one answer which dominates all the others, because there are competing considerations here. The current policy—we describe in our testimony—well, depending upon how you look at it, you can either say it's an ambiguous policy or you can say that it's a compromise policy. It's an effort to ride two horses at once. It's an effort to keep the shuttle viable and increase our capabilities little by little for reusable space transportation, but not to close off the expendable launch vehicle option. And that's—that as a response to a confused and ambiguous situation may not be all that unreasonable.

But it's important to understand that it is—it does represent a departure from the policy you characterized as having been the case when the shuttle program was started, that that was to become the space transportation system. And the principal reason for that departure, as Ray just said, is that the shuttle has turned out to be a harder job to do than some people thought back in 1972.

Mr. NELSON. Thank you, Mr. Chairman.

Mr. VOLKMER. I recognize the gentleman from Washington.

Mr. CHANDLER. I had to leave for a few minutes and I apologize if I ask a question that's already been answered. But in the discussion it seems that we've addressed pricing of the shuttle but that's only a third of the economic equation, I think; the other being demand and supply.

I would be interested in your comments on the ability of those suppliers presently in the market—obviously, Ariane and the shuttle, and whatever else might exist—to take care of whatever demand there is. And then what are your assumptions about future demand for launching of commercial?

Mr. WILLIAMSON. In our full report, which as I mentioned earlier will be available in September, we lay out a couple of demand scenarios for launch services. And what we've tried to do is there is to take the most optimistic and the most pessimistic views of that and then apply some of our own judgment to those views, and come up with a range.

And as it looks now, the range of demand that is implied by these—on the low end could easily be satisfied by the shuttle. On the high end, then we begin to need some expendable launchers or an additional shuttle.

The—we are finding it very difficult at this stage to project which one we think is the most likely. And the—we opted for being a bit safe and present both and then show how in the report how what affects the demand. So that as we look at it in the next couple of years we will be able to see exactly what might transpire in the first part of the next decade.

So I think right now it's a little early to tell if some of these commercial processes such as the McDonnell Douglas, Johnson & Johnson attempt to make biologicals in space pans out, then I think we'll see some considerably increased interest in the use of space for manufacturing purposes, and demand could easily go up.

The whole question, for instance, of what demand there will be for satellite telecommunications has a big impact on this whole question. And that's further impacted by the appearance of fiber optics cables which could send telecommunications traffic under the ocean, basically, to Europe and to Asia.

So, there are a lot of things going on right now and I think for the next couple of years it's going to be really unclear what our demand will be. So we don't have a good answer for you. And I wish we had a better one, but we don't have a good crystal ball on that.

Mr. CHANDLER. If we adopted, just for argument's sake, the policy that we are going to price shuttle launches at or as near to what we assume would be a private ELV launch, would that, assuming the higher demand level, make the Ariane's price irrelevant or would they be able to increase capacity to, in effect, make our privatization and commercialization impossible?

Mr. WILLIAMSON. They could certainly increase their capacity to meet extra demand. There are certain limits to what they can—

how fast they can increase. For instance, they are building a second launch pad right now, and that will help a lot in the number of launches they can put up per year.

But I think what we'll see in this, should that happen, should we get increased demand and we raise some shuttle prices, is that the Ariane prices would likely go up too, because they're subsidized, and the French Government would just as soon subsidize less than more. And a few satellite people who prefer to put up satellites will be—will decide not to, or defer, their launches, perhaps, because the launch costs are a little bit higher. And that—the market will adjust to that.

So, the whole question—as soon as you get into the question of how the market works, and outside of strictly Government policy where you can decide on a certain number of launches per year and then try to meet that, we begin to see that the market force is coming into effect, and be able to affect prices——

Mr. **Chandler**. Sure.

Mr. **Williamson**. And costs, and the whole thing.

Mr. **Chandler**. Well, would it be fair to say, then, that I could draw the conclusion from what you said today, that you are not very bullish on a U.S. commercial ELV so long as you have a subsidized Ariane with a demand projection about what you're looking at?

Mr. **Williamson**. Well, I would say this, that the U.S. private sector has competed with foreign subsidized equipment and services in the past, and it's quite possible for the private sector to do that again in this area. It can't do it in an unrealistic way.

So the question is perhaps to adjust the shuttle pricing so that it doesn't unrealistically compete with the private sector. I mean, that would be one way to look at it.

The U.S. carriers, for instance, airline carriers, compete with subsidized European airlines all the time, and compete very well. So, I mean, it's always a problem, but they do in fact get in there and compete. And the same thing is true for aircraft manufacturers.

Mr. **Chandler**. Thank you, Mr. Chairman.

Mr. **Volkmer**. The gentleman from Florida, Mr. MacKay.

Mr. **MacKay**. On page 15 of the summary of your study you say:

> In order to spur the growth of an internationally competitive, private ELV industry, it would probably be necessary to limit the shuttle primarily to Government launches or to increase the price of commercial shuttle flights substantially.

That implies that we have a policy that we would like to do that, or that we might have such a policy.

The thing that is bothering me is I am having trouble figuring out what our policy is. And if, as you also seem to imply, we now have two conflicting policies, when did we get into that posture? Or maybe we're trying to decide among three.

One of them would be to let the Air Force purchase 10 ELV's which would clearly subsidize our entry into that competitively.

Another would be to limit the shuttle, raise its prices and let our own private sector do that, which you say might mean that the Ariane would take a bigger share of the market.

And the third would be to continue what I thought our policy was, which was to have the shuttle compete with the Ariane.

Now, when did we get—what is your evaluation? The OTA has studied this. What is your evaluation as to what our policy on policies are, and who's advocating which one, and who do you think is winning? [Laughter.]

Mr. WILLIAMSON. Well, about the latter, I'm not sure I can answer that one. But——

Mr. MACKAY. In other words, I'd like, as long as that seems to be the game, I'd like for us to be as much a part of the game as——

Mr. WILLIAMSON. Sure.

Mr. MACKAY. We can, since we're the oversight committee, and since I think you are working for us, I want you to tell us what everybody else knows. [Laughter.]

Mr. WILLIAMSON. I'll try to do so. I think Mr. Nelson really put his finger on it earlier in mentioning that when we committed to the shuttle in 1972, the plan at that time was to develop this national space transportation system.

And I would—I'd venture to say—this is an opinion, it's not based on OTA analysis, but an opinion of mine from what I've seen over the last several years—that had we been successful in producing the first shuttle flight some several years earlier and really having a truly operational fleet at this time, that we might not be where we are today. And that's really not to point the fingers at anybody except to say that, gee, it's simply——

Mr. MACKAY. It's a tougher job.

Mr. WILLIAMSON. Turned out to be a lot tougher job than anybody realized. We're using state-of-the-art technology in many areas of the shuttle.

Mr. NELSON. Will the gentleman yield?

Or if other things coincidental with the shuttle might have worked, such as the IUS, that kind of stuff.

Mr. WILLIAMSON. There's some other—there's obviously some other technological problems we've had as well.

Mr. NELSON. Thank you, Mr. MacKay.

Mr. WILLIAMSON. And part of that is what we're seeing is the development of a very complex technological system and we haven't attempted a lot of that in the past. I mean, we've seen it certainly in atomic reactors, where we've had a lot of growing pains in that realm.

We never saw it before because things like the steam engine, for instance, actually sort of sat off on the sidelines and nobody used it for a long period of time—or very few people used it—while it was improved.

And here we've got the national attention focused on the shuttle and, gee, it had to work, and it had to work. And at hearing after hearing we have heard over the years of this problem and that problem and, well, the shuttle program needs more money to solve some of these very difficult technological problems. So there's no big surprise in that, I think.

So, we do have that policy. On the other hand, we've also seen this upsurgence of interest by the private sector. They're finally beginning to say, we see the possibility of profits in space. And so we see companies like SSI, for instance, attempting to develop their own launcher. We see other firms that are very much interested in putting up, say, interorbit vehicles of various kinds.

And I think part of the reason we are where we are is because of this tremendous desire to involve the private sector. When it comes to marketing, when it comes to developing new technologies and really making them workable for customers, clearly the private sector is hands down better than the Government at doing that.

Mr. MacKay. Well, then, so a fourth policy could be to contract out the operational phase of the shuttle program and let the private sector have it and try to market it. Would that not be true? In other words, are we not also backing into a position where NASA's going to be an operating kind of like a Greyhound bus instead of a research——

Mr. Williamson. I suppose that's certainly one possibility.

Mr. MacKay. Somebody has apparently discarded that possibility.

Mr. Williamson. Well, in the—it certainly was discussed more several years ago than it's being discussed right now. A goodly portion of NASA's operations at the cape, in fact, nearly all of it is contracted out except for the various oversight that NASA gives to the contractors at the cape.

Mr. MacKay. Well, then, let me phrase——

Mr. Williamson. So the private sector's already involved in that in a kind of contractual way.

Mr. MacKay. But I'm talking about turning the system over to them as we're talking about Landsat. They had in request for proposals to take the thing and let us subsidize and guarantee a certain number of loads, and let them market it.

Mr. Williamson. I think the concern there of that we would have to be aware of is the question of control over the transportation system at that point. And then the real question—and I think that's a real part of that whole—was part of that discussion several years ago, and is, I think, an important part today.

It could turn out, I suppose, that if the military pulled out of using the shuttle, for their own reasons, then that question of transferring the shuttle operations to the private sector could come up again in a very strong way.

I don't see it as an option right now but changing conditions could make that an option.

Mr. MacKay. Well, we are sort of on notice that the military is considering that.

Mr. Sharfman. No; they are not considering pulling out. They are considering supplementing their use of the shuttle with some expendables. But the 10 ELV's are a very long way from being able to carry all of the payloads at the military, including in that the intelligence community as well, are going to want to put into orbit over the next few years.

What the military is after is having a backup, so that if there is a serious problem with the shuttle, and there is a payload that they absolutely must get into orbit, and must get into orbit fast, they have the ability to do that. And, you know, in other context, it is becoming now fashionable to call attention to the fact that the military and the intelligence community rely upon some very high value satellites for which there are not—there is not much in the way of redundancy or backup. And there is a pressure now to create redundancy or backup that that, in turn, produces pressure to have redundancy and backup in being able to launch them.

Mr. **MacKay**. So that's it. What I'm trying to figure out is what is on the scene now that wasn't foreseeable in 1972 and 1977 and earlier times. And it appears to me that one of the things that's new is a policy of spurring the growth of an internationally competitive private ELV industry.

Mr. **Williamson**. I think that's one thing. As far——

Mr. **MacKay**. Somebody's decided that in addition to what we are now doing, we ought to also be doing that.

Mr. **Williamson**. That might——

Mr. **MacKay**. In order to do that, we are going to cut into a program we are already committed to and have invested billions into.

Mr. **Williamson**. That's the danger in—that you invest——

Mr. **MacKay**. That's new; that's new.

And then the second thing that's new is we've decided now that we've got to have backup in redundant systems.

Mr. **Sharfman**. And a third——

Mr. **MacKay**. What if we just gave them the shuttle?

Mr. **Williamson**. Gave——

Mr. **MacKay**. The military.

If that's the real issue, why don't we just face that issue? Maybe that's the cheapest way out. And then let the private sector do what it wants to with ELV's?

Mr. **Williamson**. I think we'd find ourselves in a position there of then going to the military for all of the NASA satellites that they would—and test facilities that they'd like to put up on a shuttle. We'd also have a problem with having——

Mr. **MacKay**. Well, maybe NASA could come up with a private ELV.

Mr. **Williamson** [continuing]. Our international cooperative programs.

We'd have a serious problem with our International Cooperative Programs that might want to use the shuttle if it were owned by the military.

Mr. **Lujan**. With what? Would you repeat that?

Mr. **Williamson**. I said we'd have a serious problem with our International Cooperative Programs in space if the shuttle were owned by the military.

Mr. **Lujan**. If you would yield—would you explain that? Why wouldn't Japan want to put a satellite in a craft owned by the military rather than owned by NASA?

Mr. **Williamson**. Well, the question is, for instance, in the ESA charter, European Space Agency charter, in my understanding, would not allow ESA to cooperate with the United States in what would be seen by some as a military project.

The question is not would it be a military project, but could it be seen as a politic—it's a political question, in other words, that we're talking about here. That would put the European Space Agency in a very, very bad position, I think.

Mr. **MacKay**. I guess your study, which is entitled "International Cooperation and Competition"—I'm trying to ask different questions because I see the problem as cooperation and competition among American agencies.

Mr. **Williamson**. I studied. [Laughter.]

Mr. **MacKay**. I see us trying to pretend like we don't see that. It's almost like we've got to have on a set of blinders to pretend like that's not going on. And I'm asking you, what are the consequences of Congress continuing to pretend like we don't notice that?

Mr. **Williamson**. Well, I think we say pretty clearly in our report that we shouldn't pretend we don't see it, and that there the issue should be resolved. And, I hope that our—the full chapter in the case of space transportation of that report, which the committee staff has—will provide some guidance about how to think about that problem.

Mr. **Sharfman**. There's an additional point, which is that underlying a lot of the conflict within the executive branch over the years have been disagreements about how much money should be spent on the civilian space program. And there was an earlier reference to conflicts between NASA and Commerce. Well, that's nothing as to the conflicts between NASA and OMB.

Now, Congress has the constitutional responsibility to decide how much money is going to be spent on what purposes. And that kind of issues really underlies a lot of this. And in addition to the points you mentioned about what's new, the idea of involving the private sector, the idea of having redundancy or backup for military uses, is the fact that the shuttle has cost more than we thought it was going to in 1972. And the projections of what it would cost if the shuttle were to become the dominant space transportation mode in the future show increasing costs still.

Again, this ties into the issue of whether the United States should be moving toward having some sort of permanent infrastructure in space, a space station or whatever. And, if so, how big, how fast, with what purposes, with what kind of budget.

If a space station is to be large and built soon, then we are at the high end of the demand scenarios that Ray was referring to earlier—the shuttle is full, there is pressure for an additional orbiter, or two additional orbiters, and there's plenty of business for Ariane and perhaps for the private sector as well. But, nobody supposes that that would be cheap. And there isn't really a clear national policy with both the executive branch and Congress signed onto it as to how much money is going to be spent on civilian space activities over the next 10 or 15 years.

Mr. **MacKay**. Thank you. Thank you, Mr. Chairman.

Mr. **Volkmer**. I'd like to address a few other issues, if we may. I'd like to get into the Intelsat question. How do you view the effect on our international cooperative efforts in the event that the administration would go ahead with permitting other companies to compete with Intelsat in the international communications field?

Mr. **Williamson**. Well, it's not, I think, quite clear what the economic harm to Intelsat would be if other companies, U.S. companies, come into the act. On the face of it, some of those companies are offering services, or would be offering services, which would not necessarily compete directly with Intelsat.

On the other hand, opening up that—is that me?

Mr. Volkmer. No, that's—we have a vote on. Go ahead.

Mr. Williamson. Opening up the—OK. Opening up the international telecommunications business to that kind of competition could cause Intelsat economic harm in the long run, mainly because there are more possible entries than a few companies that have already—have already submitted applications to put satellites.

So, in the past, the United States has been a very strong supporter of Intelsat. Its been an organization where the various com—countries with vastly different political systems can work together to do something for the overall benefit of the world. And Intelsat has been there as telecommunications demand has increased, and Intelsat has been there to meet that demand.

Now, at the same time, Intelsat has had a few regional systems which in some sense could be thought of as taking some business away from Intelsat. And it's judged that those regional systems, because they're primarily regional, would not harm Intelsat.

So I think the question for the United States is to judge—and I don't think it's OTA's position to make that judgment but to draw out the conflicts as clearly as possible—to judge whether in the long run our international relations are best served by continuing to support Intelsat, or are best served by permitting international competition. My—our guess is, from looking at the number of applicants and the—on the U.S. scene and also looking at the possibilities in Europe, to start with, that businesses of other countries might want to get into the act and set up competing systems; competing with the United States and also competing with Intelsat.

So, I think we face a very difficult decision right now. And I'd be hard-pressed to say which way I thought it should go.

Mr. Volkmer. But there are ramifications more severe if we do permit other private carriers to go into international competition?

Mr. Williamson. Well, it's not absolutely clear. The question that Intelsat is concerned about is, of course, the question of economic harm. The question that——

Mr. Volkmer. What about the relationships with the 100 or more underdeveloped nations, the ones that perhaps won't be able to utilize the private carriers in the event that you have the private carriers? You probably wouldn't go to those markets anyway——

Mr. Williamson. Well, in fact the first entrance would certainly not serve those markets. And Intelsat would be the one carrier which is able to serve the developing countries——

Mr. Volkmer. Is required to?

Mr. Williamson. Newly industrialized countries. Yes, they are required to.

The it's possible that their prices would go up for those areas, but it's not absolutely clear that that's the case.

Mr. Volkmer. The other question, in the summary, again, of the report, on page 30, you make a statement here that, "The conduct of foreign policy is the responsibility of the Department of State, which has little expertise in space * * * it will be important to expand the Department of State's space expertise."

Do you see that as a immediate concern to be taken care of?

Mr. **Williamson.** I think it is an immediate concern. I'm not quite sure how the Department of State might want to respond to such a concern in detail. But certainly by having more people that are highly technically competent in space and also aware of the political international ramifications, would be very useful.

It's a, as I understand it, a continuing concern of several subcommittees of the Congress that the State Department increase its overall technical competence. And certainly in space that would be a big help.

Another possibility is in some way or other to increase their coordination with NASA.

Mr. **Volkmer.** And last, then we are going to have to recess for this vote, in June, the United States walked out of the U.N. meeting of the Committee on the Peaceful Use of Outer Space [COPUOS] in response to the increasing domination disarmament issues with consequent deemphasis on scientific and technical matters.

What in fact do you foresee if the United States decides to pull out of COPUOS?

Mr. **Williamson.** I'll ask Dr. Sharfman to answer that question.

Mr. **Sharfman.** Well, if the United States pulls out of COPUOS, COPUOS as a whole would certainly be less important in the general scheme of things. But the United States would lose one avenue for influencing the way in which other countries in the world think about space issues; and one avenue for organizing multilateral as distinct from bilateral cooperation.

Now, the United States position in COPUOS recently has been a very difficult one. There are two reasons for this. One reason is that the evolution of staffing changes within the U.N. Secretariat has left us in the position where we have little or no influence on the staff that supports COPUOS for the first time in the history of that institution, and that makes things difficult.

The second thing is that on—there is a major issue in the minds of most of the other countries that are members of COPUOS where the United States is in a minority, indeed, perhaps a minority of one. And that issue is whether the sharp line between military and civilian use of space, which was perceived to exist for a number of years; and in fact, the perception was that distinction was very sharp even while the reality was that that distinction was not so sharp.

But most of the other countries that are members of COPUOS see an advantage in retaining that distinction and in retaining the perception of that distinction. And the United States has taken the line in the last 3 years that emphasis on that distinction essentially serves the purposes of those who would like to inhibit our military use of space while not contributing in any significant way to the effective civilian use of space.

So, we found ourselves at Unispace 1982 and we have found ourselves ever since in a situation in which not only the countries such as the Soviet Union, which we expect to criticize our programs, but also our friends and allies on this point, don't think very much of our position. That makes it kind of difficult to take advantage of COPUOS to carry out the sorts of cooperative efforts that we've done in the past and want to do in the future.

Now, if you look at the history of COPUOS, you see that there was in parallel work on broad policy issues and work on technical issues. COPUOS was the forum within which the 1967 Treaty on Outer Space was negotiated and in some degree you could call that a disarmament treaty, an arms control treaty; it, among other things, forbids the placement of weapons of mass destruction in orbit.

So you can't say on historical grounds that COPUOS never had anything to do with limiting or restricting military uses of space. But what it did was do that and technical things, such as liability agreements, or return or astronauts, or whatever, in parallel; and the two benefited from each other. And that has now broken down.

And the real question is whether the United States is prepared to make an effort to revive COPUOS as an institution that can be useful to us, or whether the United States wants to attend meetings with the idea not of accomplishing anything but simply keeping lines of communication open; or whether the United States simply wants to register that in that particular arena our preferred policies have lost, and have lost so badly, that there's no point in continuing the game.

Mr. VOLKMER. Thank you. I'm going to recess, and we'll be back in about 10 minutes.

[Recess.]

Mr. VOLKMER. The subcommittee will come to order.

It was brought to my attention that, Dr. Williamson, that—OTA would be able to submit, for the record, other background information on the origin of the current conflict between pricing on the ELV and shuttle. And I'd appreciate it if you would provide that.

Mr. WILLIAMSON. Be very happy to.

Mr. VOLKMER. And also on the ramifications and problems in regard to the question on the Intelsat and the pending private applications to servicing market, I'd appreciate that.

Mr. WILLIAMSON. Be glad to.

[The information follows:]

ADDITIONAL INFORMATION FOR THE RECORD

1. What are the origins of the current conflict between Shuttle pricing and commercialization of expendable launch vehicles?

In the early 1970s, the Space Task Group, a special task force empaneled by President Nixon, identified the Shuttle as the next major technological development in space, even though the Department of Defense was not an enthusiastic supporter. President Nixon, by directing that the Shuttle would be a national system serving both civilian and DOD payloads, brought DOD requirements into the design process and made possible some DOD funding. Successive administrations have continued the commitment to the Shuttle and the national space transportation system (STS) to supply the Nation's needs for space transportation.

This meant that expendable launch vehicles were to be phased out on the grounds that the Nation could not afford to maintain both capabilities. Accordingly, NASA declined to order new Delta or Atlas-Centaur vehicles after 1982 for its use. Early in 1983 the DOD also announced that it was stopping production of the Titan vehicle.

When it was clear that NASA and DOD would no longer launch expendable launch vehicles (ELVs), several private sector firms expressed interest in providing this service on a commercial basis, and encouraged the White House to develop policy supporting their efforts. On May 16, 1983, the Administration announced that "the U.S. Government fully endorses and will facilitate commercial operations of ELVs by the U.S. private sector." One of the President's basic space goals was to "ensure a flexible and robust U.S.

launch posture to maintain space transportation leadership."

This ELV policy statement also emphasized that the Shuttle is the "primary launch vehicle for the U.S. Government" and that it would also continue to be available for domestic and foreign commercial users. NASA interprets this policy to mean that the Government will not only take care of its own needs, but also participate actively as a commercial competitor in the overall launch market. This is where the price of the Shuttle to commercial customers becomes important. Free market competition among private ELV suppliers may be meaningless if all domestic ELVs are non-competitive vis-a-vis the Shuttle. Potential private launch service suppliers are questioning whether Shuttle prices for commercial launches are too low. In their view, making ELVs competitive requires removing part or all of the Shuttle's subsidy, i.e., raising Shuttle prices. (Of course, this would also strengthen the competitive position of the French launch marketing company, Arianespace.)

Because the Shuttle is operated to serve DOD as well as civilian needs, the concern of the DOD with respect to launching by means of expendable launchers is also part of the Shuttle-ELV question. The Air Force is concerned about reliability of the Shuttle and assured access to launch services upon demand, and recently asked Congress to approve procurement of at least 10 ELVs over the next 5 years, to serve as back-up to the Shuttle. Approval of this procurement could boost the ability of at least one commercial launch company to obtain launchers since a minimum production of some 4-5 launchers per year is needed to keep unit costs competitive with Ariane. Such a procurement would raise the question of whether Air Force launchers are intended to be used or held in reserve.

2. Please summarize the situation with respect to INTELSAT and the pending private applications to the international satellite communications service market.

U.S. Government choices about U.S. firms' desires to offer parallel or competitive satellite facilities to INTELSAT can be grouped into three principal options. It could:

- Attempt to preserve the current system, with INTELSAT continuing to carry the preponderant amount of intercontinental traffic and regional systems handling some intra-regional communications.
- Permit U.S. firms to offer limited and/or specialized intercontinental satellite services (in addition to the regional, transborder, North-American services they now offer), but only if it is satisfied that this limited competition will not cause a major change in INTELSAT's position. Under this option, INTELSAT would be expected to retain the bulk of the market it has traditionally served, and transponder overcapacity would be regulated, if necessary, to stay within manageable limits.
- Abandon the idea of a single global intercontinental system, allowing U.S. firms to competitively offer as much and as many different kinds of international satellite service as they wish (and can find interconnections for) and expect INTELSAT to adjust accordingly.

The question of competition to INTELSAT involves two objectives which probably conflict with each other: 1) maximum competitive access for U.S. telecommunications carriers (along with, it is hoped, cheaper and better service for their customers), and 2) preservation of the "single global system" for foreign policy and, perhaps, economic reasons. Little opposition exists in the United States to the general ideas of increased competitive access for U.S. firms and fair international competition. Workable competition is expected to bring substantial benefits for consumers in terms of lower prices and a wider array of service options. In intercontinental communications, however, there may be special circumstances that would prevent this sector from achieving workable competition (and its benefits). Even if some measure of competition were established, it might, without regulatory restriction, result in socially wasteful overcapacity.

On the foreign policy side, there is general agreement that U.S. policy toward INTELSAT in the past has engendered international goodwill and has therefore furthered general U.S. foreign policy objectives. On the other hand, the U.S. domestic model of the competitive provision of "basic public services" by lightly regulated private companies is often severely criticized in other countries. To date virtually none have organized their domestic industries in this way, although there have been some moves to increase competition in the United Kingdom and Japan. For this reason, there is likely to be a significant foreign policy cost to the United States in making what others perceive to be unilateral changes in an international system. The question is whether the economic benefits to be secured by increased competition would be worth the economic problems and trade frictions that might result. There is also the question of what will happen to INTELSAT's charges to LDCs if its North Atlantic revenues are reduced.

The options can be seen as reflecting different tradeoffs between the the pros and cons. One argument in favor of Option 2, the "go slow" option, is that it would allow some measurement of at least the service and cost performance of alternative intercontinental satellite systems and thereby allow a better estimate of the costs or benefits to American consumers and to developing countries of maintaining INTELSAT essentially intact. An argument against it is that the new entrants might not act like competitors in the absence of open entry, even if they were allowed to do so, and consumers might therefore not get the benefits of competition.

Realistically, the conditions for competition with INTELSAT will be complicated by a number of aspects of the international telecommunications industry. For instance, the United States cannot decide unilaterally to allow effective competition to INTELSAT; any U.S. firms wishing to compete with INTELSAT will either need to interconnect with a foreign carrier or receive the unlikely permission of the foreign government involved to operate on its territory. Interconnection, moreover, does not mean non-discriminatory treatment. For this to occur, the Post, Telephone and Telegraph organization (PTT) would have to agree to send communications it originates via the U.S. carriers' satellite facilities (according to some formula or in reponse to the U.S. carrier's price-service offering) in competition with the INTELSAT facilities of which it is part owner. Furthermore, communications over the U.S. carriers' satellite facilities would be subject to regulation by the foreign government, and this regulation might restrict their ability to compete. Reciprocal access of communications carried via foreign-owned satellites into the United States would also in many cases be a condition for the entry of communications carried by U.S.-owned satellite operations into foreign countries, if, indeed, private ownership of transponder capacity for the purpose of common carriage were allowed at all. All of these factors would complicate the competitive environment, as U.S. firms attempted to enter.

Mr. **Lujan**. Mr. Chairman, could I make a suggestion before we get off of that?

Mr. **Volkmer**. Yes.

Mr. **Lujan**. On the shuttle pricing, what would be wrong with saying as long as something is experimental, get on the shuttle for free, and—~~but~~ once it's a commercial venture, then you pay a good solid price for that and include it in your pricing structure?

Mr. **Williamson**. That is in fact what NASA has attempted to do with the joint endeavor agreement in which NASA has free or very low cost transportation prices to the private entrepreneur, the—and the question there would be could that program be expanded or something like it be expanded in such a case, and that's one area that the committee might want to look into for NASA. But they are attempting to do that.

It's a very difficult procedure at this—from what we hear from private industry, is that they find it very difficult to set up a joint endeavor agreement with NASA and NASA might look at that in more detail and especially with this new commercialization initiative, and expand those agreements. That would help, considerably.

Mr. **Volkmer**. I would like to proceed on with one other area.

In the past, our international cooperative relationships in space have been shaped by the Government on the Government level. Now we are seeing an increase in commercialization and privatization of space. How can we increase the role of the private sector in shaping these relationships?

Mr. **Williamson**. Well, one of the ways we can do that is indicated, I think, in the National Space Commission, which was recently mandated by legislation initiated in this subcommittee. And where people, not only in the private sector, but also with considerable experience, will attempt to identify some future goals and objectives for the space program. That's one area.

I think by making the possibility for formal input into the decisionmaking process on space by the private sector, and by different elements of the private sector, not just the aerospace corporations, which obviously have a stake in space, but some other organizations which might in the future have a stake in space, to include some of those in discussions, both with NASA and with State, the State Department as it organizes to participate in various international organizations. I mean, one of the things we saw at—with the participation, or the preparation, rather, for the participation for UNISPACE 1982 was that the private sector was pulled in at the very last minute in terms of who the actual delegates to UNISPACE 1982 were going to be.

We said in our technical memorandum on that issue that—that it would have been better had the private sector been brought in much earlier. They would have known better what was expected of them and they would have had an influence on the process.

I think as the private sector gets more involved in space, they are going to have to have both some responsibility and some say in exactly how things go.

Mr. **Volkmer**. Uh-huh. Thank you. I have no further questions.

Mr. **Lujan**. No.

Mr. **Volkmer**. I thank both of you for being here. You have been very helpful to the committee and I appreciate your testimony here today.

Mr. **Williamson**. Thank you, Mr. Chairman.

[Additional questions submitted to Dr. Williamson and responses follow:]

Subcommittee on Space Science and Applications
Answers to additional questions for the record
Hearing on International Cooperation and Competition in Space
July 25, 1984

1. What would you identify as the two most important issues affecting U.S. cooperation and competition in space for Congressional attention?

In OTA's view, the two most important issues affecting U.S. cooperation and competitition that require Congressional oversight and legislation are:

A) How can the United States best respond to the growing international competition in space? Because some eight U.S. agencies now have responsibilities and authority for overseeing some aspects of U.S. space activities, responding to international competition will require more effective coordination among Government agencies, and between Government and interested elements of the private sector.

B) How can the Government more effectively involve the private sector in space? Barriers of cost and high technological and economic risk continue to deter significant private investment in new space technology. Competition by the Government in space transportation and in some areas of land remote sensing are also significant impediments.

2. For the most part, our international cooperative relationships in space have been shaped at the government level. Now that we are seeing increasing commercialization and privatization of space--

A) How can we increase the role of the private sector in shaping these relationships?

One important way would be to involve the private sector in a formal advisory capacity. The problem is that those who shape international cooperative relationships are seldom aware of the private sector's concerns, nor does the private sector fully appreciate the foreign policy implications of actions they might wish to pursue in space. For example, a private firm selling remotely sensed data would prefer not to be under the constraint of having to sell data in a non-discriminatory manner. Yet, other countries could find restrictive sales threatening, particularly if third parties were able to obtain high resolution data about their country before they could obtain them.

Government agencies could also enlist the help of the private sector in providing training and other assistance to technical personnel in developing countries.

Finally, private sector participants in international conferences should be named well in advance (one-year minimum; two-years ideally) so that they can make a real contribution to the planning and discussion of the conference in question. (See UNISPACE '82: A Context for Cooperation and Competition, pp.54-57, OTA Technical Memorandum prepared for this Subcommittee).

B) How do you see increasing commercialization and privatization affecting our international relationships in space?

From an ideological standpoint, commercialization or privatization of space technology will make it more difficult for the United States to reach agreement with other countries over the terms of the use of space resources. This is because most foreign governments have an ideological preference for dealing with the U.S. Government rather than with private firms, and also because the commercialization process creates particular friction when it is driven by general principles rather than by the requirements of an individual case. Yet, as satellite communications has demonstrated, commercial operation of some technologies could lead to major cost reductions and more efficient use of space resources. By continuing to work constructively with other countries in multilateral forums as well as bilaterally, the United States could enhance other countries' understanding and acceptance of the role of the U.S. private sector in space.

3. How do you see the development of enhanced capability in space among other nations as affecting our ability to set priorities for international cooperation in space?

The enhanced capabilities of other nations makes possible a higher level of technical cooperation than ever before. It also gives other countries greater leverage in negotiating the terms of cooperation. In other words, mankind as a whole will be able to learn more and do more in space, but at the same time, other countries will have a greater say in the direction of cooperative research and applications.

4. Some have voiced concern that as other nations expand their presence in space, by cooperating we may be encouraging the development of the industrial bases abroad, while in effect diminishing the competitive position of the U.S. in world trade. Would you agree? Can you comment?

Some cooperative projects could result in unwanted technology transfer. However, it is important to realize that technology transfer has recently become a two-way street. We now have much to gain from the knowledge of other countries as well. In arranging cooperative projects it will be important for the United States to emphasize those areas where it has much to gain from others and to minimize cooperation where it has a lot to lose.

The United States also has other objectives for cooperating -- achievement of goals which we are unable or unwilling to pursue unilaterally, cost sharing on such projects, entry to certain countries that would otherwise be difficult to achieve, and achieving some measure of control over the direction of foreign projects in space. These objectives may outweigh the dangers of technology transfer.

5. In June, the United States walked out of the U.N. meeting of the Committee on the Peaceful Uses of Outer Space (COPUOS), a response to the increasing domination of disarmament issues with the consequent deemphasis on scientific and technical matters.

   A) How would you characterize the U.S. stance at COPUOS?

   B) What impact do you foresee if the U.S. decides to pull out of COPUOS?

Mr. **Volkmer**. We will now proceed with the following three witnesses and I would like for all of them to come to the table as a panel and we will have their testimony and then proceed to question all three.

Mr. Kenneth Pedersen, Director, International Affairs Division of NASA; Mr. Otho Eskin, Director, Office of Advanced Technology, Department of State, and Dr. John McElroy, Assistant Administrator for Environmental Satellite, Data, and Information Services of NOAA.

You may proceed in the way that you are called to the table. I would also like to say that your statements will be made a part of the record, and you may review your statement in full, or if you prefer, you may summarize.

Mr. Pedersen.

STATEMENT OF KENNETH S. PEDERSEN, DIRECTOR, INTERNATIONAL AFFAIRS DIVISION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. **Pedersen**. Thank you, Mr. Chairman. With your permission, I will summarize my statement and submit the entire statement for the record.

Mr. **Volkmer**. All right.

Mr. **Pedersen**. Mr. Chairman and distinguished members of the subcommittee:

It's a pleasure to be here today to testify on international cooperation and competition in space.

President Reagan helped assure continued U.S. leadership in space when he announced in his January 25 State of the Union Message that he was directing NASA to develop a permanently manned space station and stated that NASA's activities in space will encourage greater commercial utilization. By doing so, he set in motion the machinery that will provide us a greater capability to explore and use space for our benefit. In the fine tradition of this Nation, the President is seeking to share these benefits with our friends and allies around the world by inviting international participation in the U.S. Space Station Program. Congress has endorsed this new direction for the Space Program, continuing the partnership between the legislative and executive branches of Government that has been so successful.

As you know, the National Aeronautics and Space Act states that one goal of the U.S. Civil Space Program is to cooperate with other nations in the peaceful uses of space, thus sharing the benefits of mutual, cooperative space activities. This policy has been reaffirmed by every administration and Congress since the act became law in 1958. With this mandate, NASA has pursued cooperation in almost all of its major programs.

NASA has entered into more than a thousand agreements with approximately 135 nations and international organizations. These agreements cover activities that range from major hardware participation to ground-based studies and data analysis. This subcommittee is very familiar with these activities, so I will only mention some of our more recent successes.

The infrared astronomical telescope—satellite, a cooperative project with The Netherlands and the United Kingdom, successfully conducted a comprehensive all-sky survey in the infrared region of the spectrum. COSPAS-SARSAT, an experimental multilateral program to demonstrate the use of satellites in aiding maritime and aeronautical search and rescue activities, has already been used to assist in the saving of over 200 lives. This is a project that brings together the United States, Canada, France, and the Soviet Union. And on the U.S. side, it is an interagency effort which includes not only NASA but also NOAA and several other agencies. Finally, Europe and Canada greatly expanded the space shuttle's capabilities and functions by developing the spacelab and the remote manipulator system, also known as Canadarm, respectively. The first spacelab mission brought us a tremendous amount of scientific data, and demonstrated once again man's unique contributions to scientific endeavors in space. The Canadarm most recently demonstrate its capabilities by aiding in a very prominent manner in the repair of the solar maximum mission satellite.

I would be remiss, Mr. Chairman, if I didn't also mention that next month we will be launching a mission with the rather long title of active magnetospheric particle tracer explorer, and that explains why we call it AMPTE mission, which is a joint mission with the United States, Germany, and the United Kingdom, which involves three separate spacecraft that will be studying the flow of energy in the magnetosphere by observing ionized traces of barium and lithium. So we have on the horizon very shortly a rather impressive international mission.

The United States, and we believe its partners, have found the benefits from cooperation quite rewarding. With finite resources available for space activities, international cooperation has expanded available resources, and allowed us to do more in space than we might have been able to do alone. Through cooperation, we share scientific expertise and scientific data, thus expanding our knowledge of the universe and our immediate environment. In many cases, cooperation provides us access to places and facilities which lie outside our borders and which are essential or highly beneficial to the conduct of our programs. This access is needed for reasons as diverse as collecting ground truth information to complement satellite data, and providing contingency landing sites for the shuttle. Finally, cooperation supports important foreign policy goals. It serves, among other things, as a tangible demonstration of our commitment and our ability to work with our friends and allies in peaceful pursuit in space. Furthermore, cooperative activities the benefits of space to nonspace faring nations as well.

The use of space in furthering foreign policy goals was most recently demonstrated at the London Economic Summit held this past June. Immediately after the State of the Union message, the President asked NASA Administrator Jim Beggs to visit the Summit capitals to reiterate his invitation to cooperate on the space station, and to help lay out the groundwork for the Summit discussions on the space station. The President believes that the space station can provide the focal point for free world space operations well into the next century. Furthermore, he believes that international cooperation in this program will provide a highly visible and mutually beneficial symbol of free world leadership in space and of the Summit nations' commitment to work together. That's one of the reasons why the space station was one of the major—six major themes for the United States at this year's Summit.

We all realize, of course, that our potential partners for the Space Station Program and for other space activities are, in some areas, our competitors as well. Foreign aerospace companies are extremely capable, and space has become an important part of the economic and political strategies of other nations. Space budgets in these countries have also remained at comparatively high levels, and have shown an increased emphasis in areas of potential commercial payoff.

There's no need for me to tell this subcommittee about the highlights of other nations' space programs, such as the European Ariane launch vehicle, and the communications and remote sensing programs in Europe and Japan.

We see evidence that other governments are adopting sophisticated strategies to enhance their aerospace industries' competitive positions. They support their space industry not only through R&D funding, as does the United States, but also by financing assistance, development of attractive package deals, and creations of quasigovernmental marketing organizations.

NASA shares this subcommittee's concern about this competitive challenge. With continued administration and congressional support for R&D funding, NASA conducts programs that help the United States meet this challenge. Through its research, NASA is helping maintain this country's leadership in the development and use of communications satellites and remote sensing systems. NASA is also aggressively pursuing programs to lower STS operating costs in order to increase the attractiveness of the shuttle to users. As Mr. Beggs testified to this subcommittee last month, NASA is looking at creative ways to facilitate commercial utilization of space to augment some existing NASA-industry outreach programs.

I believe it is important, however, not to let our concerns about competition and technology transfer make us lose sight of the importance of cooperation. First, increased capabilities abroad mean that other nations can be more capable partners, thus increasing the benefits to be derived from cooperative ventures.

Second, and somewhat more philosophically, the United States looks to its friends and allies to share both the benefits and the burdens of remaining free-world nations.

Furthermore, cooperative programs, properly structured, need not result in adverse transfer of technology. For 25 years, NASA has conducted its international programs in ways that protect against technology losses. Projects leading to the early development of commercially useful technology are not usually open for international participation.

In projects where there is international involvement, protection against unwarranted technology transfer is accomplished primarily through insistence that each party to the cooperative project undertake to develop a discrete piece of hardware completely at its own expense, for which it has full responsibility and for which it has the necessary technological capability. I would emphasize that the nature of the space station architecture, which will be modular and distributed in form, is particularly well suited to this kind of arrangement. Only the minimum amount of technical information necessary to ensure effective interfaces among the various elements of the project needs to be exchanged. Interestingly, I would point out too, that technology transfer is a concern of NASA's space partners who now increasingly have their own space capabilities to protect and to nurture.

In the 26 years since the inception of the U.S. space program, we have begun to realize the commercial potential of the space environment. Other space faring nations have done the same. Both we and they have developed capabilities to find profit in space. This is an extremely attractive outgrowth of Government expenditures. The United States should continue to work aggressively to maintain its competitive edge.

There is still plenty of room, however, for us to work together to demonstrate our mutual commitment to using space for peaceful purposes for all mankind.

This concludes my statement, Mr. Chairman.

[The prepared statement, plus responses to written questions submitted to Mr. Pedersen follows:]

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PRESENTED BY WITNESS

JULY 25, 1984

Statement of

Kenneth S. Pedersen
Director
International Affairs Division

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Subcommittee on Space Science and Applications
Committee on Science and Technology
House of Representatives

Mr. Chairman and Distinguished Members of the Subcommittee:

It is a pleasure to be here today to testify on international cooperation and competition in space.

President Reagan helped assure continued U.S. leadership in space when he announced in his January 25 State of the Union message that he was directing NASA to develop a permanently manned Space Station and stated that NASA's activities in space will encourage greater commercial utilization. By doing so, he set in motion the machinery that will provide us a greater capability to explore and use space for our benefit. In the fine tradition of this great nation, the President is seeking to share these benefits with our friends and allies around the world by inviting international participation in the U.S. Space Station program. Congress has endorsed this new direction for our space program, continuing the partnership between the Legislative and Executive branches of government that has been so successful.

As you know, the National Aeronautics and Space Act states that one goal of the U.S. civil space program is to cooperate with other nations in the peaceful uses of space, thus sharing the benefits of mutual, cooperative space activities. This policy has been reaffirmed by every Administration and Congress since the Act became law in 1958. With this mandate, NASA has pursued cooperation in almost all of its major programs.

NASA has entered into more than a thousand agreements with approximately 135 nations and international organizations. These agreements cover activities that range from major hardware participation to ground-based studies and data analysis. This Subcommittee is very familiar with these activities, so I will only mention some of our more notable successes:

The Infrared Astronomical Satellite, a cooperative project with the Netherlands and the United Kingdom, successfully conducted a comprehensive all-sky survey in the infrared region of the spectrum. COSPAS-SARSAT, an experimental multilateral program to demonstrate the use of satellites in aiding maritime and aeronautical search and rescue activities, has already been used to assist in the saving of over 200 lives. Finally, Europe and Canada greatly extended the Space Shuttle's capabilities and functions by developing the Spacelab and Remote Manipulator System (Canadarm), respectively. The first Spacelab mission brought us a tremendous amount of scientific data, and demonstrated once again man's unique contributions to scientific endeavors in space. The Canadarm most recently demonstrated its capabilities by aiding in the repair of the Solar Maximum Mission Satellite.

The U.S. and we believe its partners have found the benefits from cooperation quite rewarding. With finite resources available for space activities, international cooperation has expanded the available resources and thus allowed us all to do more in space than we would have been able to do alone. Through cooperation, we share scientific expertise and scientific data, thus expanding our knowledge of the universe and our immediate environment. In many cases, cooperation provides us access to places and facilities which lie outside our borders. This access is needed for reasons as diverse as collecting ground truth information to complement satellite data in research programs and providing contingency landing sites for the Shuttle. Finally, cooperation supports important foreign policy goals. It serves as a tangible demonstration of our commitment and our ability to work with our friends and allies in peaceful pursuits. Furthermore, cooperative activities extend the benefits of space to non-space faring nations as well.

The use of space in furthering foreign policy goals was most recently demonstrated at the London Economic Summit this June. Immediately after the State of the Union, the President asked NASA Administrator James Beggs to visit the Summit capitals to reiterate his invitation to cooperate on the Space Station, and to help lay the groundwork for the Summit discussions on the Space Station. The President believes that the Space Station can provide the focal point for free world space operations well into the next century. Furthermore, he believes that international cooperation in this program will provide a highly visible and mutually beneficial symbol of free world leadership in space and of the Summit nations' commitment to working together. That is why the Space Station was one of the six major themes for the U.S. at this year's Summit.

At the close of the Summit, the participants gathered around a model of the Space Station and discussed future space cooperation. A communique was issued on the major topics discussed and agreed to at the Summit. The communique welcomed the U.S. invitation for international participation in its Space Station program, acknowledged the benefits of such a program to technological and economic growth, and noted that the Summit partners would examine the nature of their potential participation in the project. The U.S. undertook to report on the status of international participation in the program at the 1985 Economic Summit to be held in Bonn, Germany. Upon French request, the communique also alluded to the possible future development of a European Space Station.

We all realize, of course, that our potential partners for the Space Station program and for our other space activities are, in some areas, our competitors as well. Foreign aerospace companies are extremely capable, and space has become an important part of the economic and political strategies of other nations. Space budgets in these countries have also remained at comparatively high levels, and have shown an increased emphasis in areas of potential commercial payoff.

There is no need for me to tell this Subcommittee about the highlights of other nations' space programs, such as the European Ariane launch vehicle, and the communications and remote sensing programs in Europe and Japan.

We also see increasing evidence that other governments are adopting sophisticated strategies to enhance their aerospace industries' competitive positions. These governments support their space industry not only through R&D funding as does the U.S., but also by financing assistance, development of attractive package deals, and creation of quasi-governmental marketing organizations.

NASA shares this Subcommittee's concern about this competitive challenge. With continued Administration and Congressional support for R&D funding, NASA conducts programs that help the U.S. meet this challenge. Through its research, NASA is helping maintain this country's leadership in the development and use of communications satellites and remote sensing systems. NASA is also aggressively pursuing programs to lower STS operating costs in order to increase the attractiveness of the

Shuttle to users. As Mr. Beggs testified to this Subcommittee last month, NASA is looking at creative ways to "facilitate" commercial utilization of space to augment some existing NASA-industry outreach programs.

Finally, NASA is a member of the Advisory Committee on Export Policy which was established under the Department of Commerce to review export license requests from U.S. industry. NASA is charged in the Space Act with assuring the primacy of U.S. space and aeronautics technology. NASA is thus well positioned to provide its expertise to the interagency forum to assess the commercial implications of technology transfer policies for the health and well being of the space industry as a whole.

I believe it is important, however, not to let our concerns about competition and technology transfer make us lose sight of the importance of cooperation. First, increased capabilities abroad mean that other nations are more capable partners, thus increasing the benefits to be derived from cooperative ventures. Secondly, and more philosophically, the United States looks to its friends and allies to share both the benefits and the burdens of being free world nations. Furthermore, cooperative programs, properly structured, will not result in adverse transfer of technology. For 25 years, NASA has conducted its international programs in ways that protect against technology losses. Projects leading to the early development of commercially useful technology are not usually open for international participation. In projects where there is international involvement, protection against unwarranted technology transfer is accomplished primarily through insistence that each party to the cooperative project agreement undertake to develop a discrete piece of hardware completely at its own expense for which it is fully responsible and for which it has the necessary technological capability. The nature of the Space Station architecture, which will be modular and distributed in form, is particularly well suited to this kind of arrangement. Only the minimum amount of technical information necessary to ensure effective interfaces among the various elements of a project is exchanged. Interestingly, technology transfer is also a growing concern of NASA's space partners who now have their own space capabilities.

In the 26 years since the inception of the U.S. space program, we have begun to realize the commercial potential of the space environment. Other space faring nations have done the same. Both we and they have developed capabilities to find profit in space. This is an extremely attractive outgrowth of government expenditures. The U.S. should continue to work aggressively to maintain its competitive edge. For NASA's part, this means working with industry and conducting strong research programs in areas of potential commercial interest. Our friends overseas will certainly be doing this in areas where they foresee commercial payoff. There is still plenty of room, however, for us to work together to demonstrate our mutual commitment to using space for peaceful purposes for all mankind.

Finally, we understand that the Subcommittee had wished NASA's views on the OTA assessment of international cooperation and competition in civilian space activities. The Administration believes that this is an important issue, and would like to be as responsive as possible. However, since the assessment is still in draft form, we believe it to be premature to make any comments on it at this time.

That concludes my statement. Thank you for the opportunity to testify before this Subcommittee today.

Questions submitted by Chairman Volkmer during the July 25, 1984, hearing at which Mr. Pedersen testified on International Cooperation and Competition in Space Activities.

Question LI-1:

As part of the President's National Policy on the commercial use of space, released last Friday (July 20), the President identified an initiative to "assure fair international competition."

a. Can you provide additional details on the legal and/or regulatory aspects of this initiative?

b. What part will NASA's Office of International Affairs play in the efforts to commercialize space?

Answer LI-1:

a. The initiative calls for an interagency study of barriers to free trade in space goods and services which could be harmful to the U.S. competitive position in this area. The conclusions of the study would determine whether or not legal or regulatory actions by the U.S. Government would be necessary.

b. The International Affairs Division has participated in the development of NASA's commercialization policies as a member of the NASA Commercialization Task Force. We will work closely with the NASA Commercialization Office when it is established, as we do with all NASA program offices. Furthermore, International Affairs already supports the Office of Space Flight in its international promotion of Shuttle services and serves as focal point for NASA's participation in interagency reviews of export licenses for space technology.

Question LI-2:

Most of the international cooperative relationships in space have been shaped as a result of government interaction. Now, we are seeing increasing commercial activity in and utilization of space.

a. How will this trend affect our international relationships?

b. Is NASA working on increasing the involvement of the private sector in shaping our international cooperative relationships? If so, how?

Answer LI-2:

a. The growth in the number of countries engaging in commercial activities in space will present both new competitive challenges as well as increased cooperative and commercial opportunities for the U.S. Government and U.S. industry. Competitive challenges require that we remain cautious in structuring our cooperative activities to ensure that the relationships are beneficial to the U.S. competitive stance and involve no unwarranted technology transfer. At the same time, prospective foreign partners will have increased capabilities and resources to contribute to cooperative projects. I expect that we will see an increase in teaming arrangements under which U.S. and foreign industry join together to bid for satellite procurements. An example of this is the Ford Aerospace/Aerospatiale relationship in building a communication satellite system for ARABSAT.

b. NASA often looks outside government for advice on our international activities. In addition to the NASA Advisory Council which reviews all NASA current and future programs, we have established other mechanisms for private sector advice specifically for the Space Station program. The Banks Committee on Scientific Uses of the Space Station is composed of many prominent scientists from the U.S. and other countries.

The recent restructuring of the Mobile Satellite (MSAT) program, a potential cooperative program with Canada, is another good example of industry involvement in our international activities. NASA had been discussing with the Canadian Department of Communications (DOC) the possibility of NASA securing access to the planned Canadian MSAT. Then, NASA became aware of U.S. industry interest in developing a mobile satellite. Thus, in discussions with DOC, NASA restructured the MSAT program whereby NASA and DOC will study the possibility of separately obtaining satellite channel capacity from U.S. and Canadian carriers. The carriers will be encouraged to work together to design and procure the space segment to meet government requirements as well as their own, and to initiate early commercial satellite service.

Question LI-3:

How does NASA coordinate its international activities with other agencies such as NOAA and the Department of State?

a. Is the current system effective?

b. What problems are there in the general arrangement?

c. How would you respond to the OTA recommendation that the Department of State's space expertise be expanded?

Answer LI-3:

This issue addressed during the hearing.

Question LI-4:

You have touched on the enthusiasm at the highest political levels for international collaboration in the Space Station.

a. Would you say that this same commitment exists at the working levels?

b. How can we best facilitate these cooperative relationships at the working level?

Answer LI-4:

a. Yes. For the past two years, NASA has been working closely with the working level staff in the agencies with space-related responsibilities in Europe, Japan and Canada. Their enthusiasm and commitment can be attested to by the fact that they were the ones to initiate studies parallel to ours in the predefinition phase, and the active dialogue we've had. Through the efforts of these working level staffs, the politicians in their countries were made aware of the numerous benefits to be gained from cooperation on the Space Station.

b. The best way to facilitate these relationships is to maintain an active dialogue to promote prompt, informed decison-making abroad. NASA is doing this multilaterally through international workshops we have been holding fairly regularly, as well as through bilateral discussions.

Question LI-5:

In your view, what seem to be the major concerns on the part of international partners with respect to cooperation on the Space Station?

a. What actions would you suggest be taken to allay such concerns?

Answer LI-5:

Limitations on access to the Space Station, potential militarization of the Space Station, technology transfer, protection of proprietary rights, long-term budget implications, and U.S. commitment to the program given the ISPM experience appear to be the major concerns of our international partners. In each of these areas, however, I believe that our plans will accommodate the reaching of mutually beneficial arrangements.

The best way to allay these concerns is by communicating. NASA is working hard to ensure that our partners are fully aware of our planning activities so that a continuous dialogue is maintained on these issues. The

Administration is committed to international cooperation on the Space Station, so NASA is working hard to understand and solve any problems in order to achieve significant and meaningful cooperation.

Question LI-6:

You have cautioned that we should not let concerns over competition and technology transfer make us lose sight of the importance of cooperation.

a. Do you believe that this is in fact occurring?

b. Have the enhanced capabilities of other national space programs affected our priority setting for international cooperation?

Answer LI-6:

a. Not yet. The Administration and Congress remain fully committed to international cooperation in the U.S. civil space program.

b. Yes. For one thing, we are able to look to other countries to carry a larger share of the responsibility for conducting space science missions. We no longer need to feel that we must take the lead in every area of space exploration; rather, we can benefit from an international "division of labor" that is more equal than ever before. Naturally, the enhanced capabilities of others also requires that we be diligent in ensuring that cooperative programs offer clear benefits to the U.S. and do not pose risks of unwarranted technology transfer.

Question LI-7:

One of the fundamental policy objectives of the Space Act is to maintain U.S. preeminence in space. Some of the cooperative materials processing research conducted between the U.S. and Europe and Japan may eventually lead to commercially valuable products.

a. How will NASA ensure that these cooperative activities do not lead to commercial competition for U.S. firms?

Answer LI-7:

The major goals of the NASA Microgravity Science and Applications Program including the Materials Processing in Space (MPS) program are threefold: (1) to conduct a basic and applied research program in materials processing technology to understand the limiting role of gravity and the enhancement possible in the control of these processes through the use of space; (2) to achieve improved processing methods and materials of technological interest; and (3) to assist early U.S. commercialization of space processing. In order to accomplish these goals and to satisfy two policy objectives of the Space Act - maintaining U.S. preeminence in space and promoting international cooperation - NASA has established a policy framework to ensure that international cooperation does not lead to commercial competition for U.S industry.

NASA will consider entering into cooperative activities in basic research, not applied research, consistent with NASA program objectives. Secondly, NASA avoids cooperation in those activities that have immediate or near-term commercial benefit since one of the primary goals of the MPS program is to promote early U.S. commercialization of space processing. Thirdly, consistent with NASA long-standing policy, all data from our cooperative projects are made freely and openly available. This further ensures that foreign partners not gain a commercial advantage since all experimental results are publicly available.

Finally, as foreign capabilities have increased, NASA is pursuing cooperative activities that utilize foreign hardware and flight opportunities in materials sciences research in order to expand the pool of resources currently available in this field. At the same time, NASA has pursued actively early U.S. industrial participation in materials sciences research in Joint Endeavor Agreements and Technical Endeavor Agreements that specifically provide protection for U.S. intellectual property rights.

Question LI-8:

Aside from the Space Station, do you anticipate any other new initiatives for NASA in international space cooperation?

Answer LI-8:

In addition to the MSAT program described in answer LI-2(b), we are discussing with Japan and ESA possible cooperation on a potential Space Science initiative, in which the three partners would contribute satellites for comprehensive investigation of the complex processes in the transfer of energy from the sun to the earth's atmosphere. We will continue to explore opportunities for mutually beneficial cooperation with potential partners around the world.

Question LI-9:

What activities does NASA currently have underway to expand the benefits of space to developing nations?

Answer LI-9:

Since the beginning of the U.S. space program, the application of space research for the benefit of national and international communities has been a major objective of U.S. government agencies. To carry out this goal, the U.S. encourages international cooperation and has developed a broad program of international activities open to involvement of foreign space agencies, academic organizations and individuals. At NASA, projects are structured such that NASA and its foreign partners are responsible for the necessary budgetary and technical resources to carry out jointly agreed upon roles when mutually beneficial scientific objectives can be achieved.

NASA has conducted cooperative projects with developing countries in many fields of particular interest and application to third world development needs. Our projects have included cooperation in remote sensing, satellite communications, alternate energy, meteorology, geodynamics, dissemination of data and technical information, and training opportunities through our Resident Research Associate Program. Our Announcements of Opportunity soliciting foreign participation in our Space Science and Applications Program are widely distributed throughout the third world. In addition, NASA works closely with many other U.S. agencies to pursue programs to develop new technologies and apply those already in existence. The Agency for International Development has the major responsibility for assisting nations to make full use of current space capabilities for development needs. Along with AID, NASA works with the Department of Commerce's National Oceanic and Atmospheric Administration and the National Technical Information Service, the Department of Interior's U.S. Geological Survey, the Department of Agriculture and the Trade and Development Program to encourage and demonstrate the application of space technology for development needs.

Question LI-10:

I'm struck that your statement doesn't mention the U.S. walkout at the COPUOS meeting in June. Mr. Eskin's outlook for COPUOS is particularly gloomy. Can you comment on NASA's view of the future of COPUOS?

Answer LI-10:

This issue addressed during the hearing.

STATEMENT OF OTHO E. ESKIN, DIRECTOR, OFFICE OF ADVANCED TECHNOLOGY, DEPARTMENT OF STATE

Mr. Eskin.

Mr. ESKIN. Thank you, Mr. Chairman. With your permission, I will summarize my statement.

Since its inception more than two decades ago, international cooperation has been an important element in the U.S. civil space program. The Department of State has been a vigorous proponent of such international cooperation. We are convinced that the United States derives important foreign relations benefits from U.S. civil space activities. An active program of international cooperation in various space-related fields will continue to characterize the U.S. approach to the use and exploration of outer space.

A dramatic example of the U.S. commitment to international cooperation in space is the manned Space Station Program announced by the President in his State of the Union address. This is a major, new and far-reaching initiative calling for international participation in a very large, long-term and complex project which will employ the latest developments in space technology.

The international arrangements may be difficult and will certainly require imagination and initiative. We will be traveling an uncharted course and must work out arrangements with few, if any, precedents to guide us.

The Department of State will work closely with NASA and other interested agencies to make this program a success—one that will promote U.S. foreign policy interests.

We are confident that, in the long run, the manned space station project can have far-reaching benefits to our partners and to ourselves.

We must also consider the factor of growing commercial competition in space. The United States has recently taken steps to enhance its international competitive position, the most important of which are the authorization and encouragement of commercial expendable launch vehicles and the expanded opportunities for commercial remote sensing applications anticipated in the transfer of the Landsat program to the private sector.

The Department of State has been a strong supporter of these steps and, in cooperation with other agencies, will work to create an international environment in which U.S. commercial space activities can effectively compete.

The principal role of the Department of State in the field of international civil space activities is to attempt to harmonize U.S. international objectives and interests, and to integrate those interests into our overall foreign policy objectives.

Of special importance to the Department of State has been U.S. participation in multilateral institutions concerned with outer space issues. Foremost among these institutions has been the U.N. Committee on the Peaceful Uses of Outer Space: COPUOS. I was head of the U.S. delegation to the most recent COPUOS meeting in Vienna last month, and I would like to share with you my impressions of the results of the meeting and to discuss the question of future participation by the United States in COPUOS.

In recent years, there has been a serious deterioration in the Committee's scientific and technical focus and an increasing tendency of the Committee to involve itself in disarmament and other matters beyond the scope of its competence. This resulted in what we generally characterize as a politization of the work of the Committee.

The Department of State and other agencies in the executive branch, especially NASA, Defense, and NOAA, have given very careful and thorough consideration to how our international space-related interests were affected by these developments in COPUOS and what our future relationship to this Committee should be. Notwithstanding the generally poor state of affairs in the Committee, and an understandable lack of enthusiasm among U.S. Government technical agencies for pursuing their interests in a forum which had become devoid of meaningful scientific and technical work, there was agreement that we should not take any precipitous action, but should consider carefully how our long-term interests would be affected either by withdrawing from the Committee or remaining involved in it.

At the same time, a business-as-usual attitude in respect to U.S. participation in the Committee was felt to be inappropriate. We decided to demonstrate our concern over recent developments in COPUOS and to act in a way which might also produce some positive changes during the meetings of COPUOS and its subcommittees in 1984.

Our actions have been calculated to make clear, first of all, that the United States is fully committed to international cooperation in the peaceful uses of outer space, but, at the same time, that the sterile, confrontational approach of bloc politics which has characterized COPUOS, is inconsistent with such cooperation.

Second, that we are examining what the future relationship with the U.S. COPUOS should be.

Third, that in the interim, our participation in COPUOS and our support for various activities under its auspices will be considerably lowered.

And, finally, that we wanted to stress that we would be pleased to work with any countries which are willing to seek more constructive ways of doing business in the Committee and to consider what the proper business of the COPUOS should be.

The cycle of COPUOS meetings for 1984 has now run its course and, while there is a great deal of work that remains to be done at the 39th session of the General Assembly this fall, I can offer some impressions of the results to date. I must inform you that, despite our efforts, as well as those of our allies, there is little room for optimism regarding the future usefulness of the Committee. The majority of the Committee's membership appear not to share the concerns of the United States and other industrialized nations regarding the need to emphasize scientific and technical issues in the Committee and to restore the consensus principle in the General Assembly's consideration of the COPUOS' work.

The report that will emerge from the 1984 session of COPUOS will reflect fundamental differences of opinion on nearly every item on the COPUOS agenda, and even some items that are not on the agenda, for example, negotiation of a new direct broadcast satellite treaty.

From the particular point of view of the Department of State, the degeneration in the Outer Space Committee has been especially troublesome, coming as it does in a period in which the United States envisages a substantial expansion in its international space-related activities, not the least of which is the Manned Space Station Program, but including, as well, expanded commercial involvement relating to launch vehicles and remote sensing satellites.

While the main elements of U.S. cooperative activities in outer space have always been conducted on a bilateral basis, the Department of State has felt that multilateral cooperation is important, that the United Nations has a significant role to play in this field, and that the COPUOS in particular has been a useful forum for the exchange of scientific and technical information and the discussion of legal issues of common interest.

In the past, U.S. participation in COPUOS has been beneficial generally by enabling the United States to engage the developing countries in a constructive manner. Unfortunately, other governments apparently no longer take the work of COPUOS as seriously as we in the United States do. It is with genuine regret that we have seen the nature of the Committee and the character of its deliberations deteriorate.

We have reached no final conclusion about the future role of the United States in this Committee and do not expect to reach any decision before the end of the year. In the meantime, we will continue to take part in the U.N. deliberations on outer space and will continue to explore ways to return the Committee to its former effectiveness which can encourage and contribute to the international cooperation in the peaceful uses of outer space.

Thank you, Mr. Chairman. I would be happy to answer any questions.

[The prepared statement of Mr. Eskin plus answers to additional questions follow:]

STATEMENT BY OTHO E. ESKIN
DIRECTOR, OFFICE OF ADVANCED TECHNOLOGY,
DEPARTMENT OF STATE
BEFORE THE HOUSE SUBCOMMITTEE ON
SPACE SCIENCE AND APPLICATIONS
JULY 25, 1984

MR. CHAIRMAN:

I APPRECIATE THE OPPORTUNITY TO TESTIFY TODAY REGARDING INTERNATIONAL COOPERATION AND COMPETITION IN SPACE AND IN PARTICULAR TO CONSIDER THE CHANGING DIMENSIONS OF OUR INTERNATIONAL SPACE POLICIES AS OTHER NATIONS DEVELOP THE CAPABILITY BOTH TO COOPERATE AND TO COMPETE WITH US IN OUTER SPACE. THE DEPARTMENT OF STATE HAS ONLY RECENTLY RECEIVED THE DRAFT REPORT PREPARED BY THE OFFICE OF TECHNOLOGY ASSESSMENT ON THIS THEME. IT IS AN IMPRESSIVE STUDY TOUCHING ON A WIDE RANGE OF U.S. CIVILIAN SPACE ACTIVITIES AND THE IMPACT OF INTERNATIONAL DEVELOPMENTS ON THESE ACTIVITIES. WE IN THE DEPARTMENT OF STATE WILL WANT TO STUDY THIS REPORT CAREFULLY AND MAY PROVIDE SPECIFIC COMMENTS TO THE SUB-COMMITTEE AT A LATER TIME.

SINCE ITS INCEPTION MORE THAN TWO DECADES AGO, INTERNATIONAL COOPERATION HAS BEEN AN IMPORTANT ELEMENT IN THE UNITED STATES' CIVIL SPACE PROGRAM. THE DEPARTMENT OF STATE HAS BEEN A VIGOROUS PROPONENT OF SUCH INTERNATIONAL COOPERATION. WE ARE

CONVINCED THAT THE UNITED STATES DERIVES IMPORTANT FOREIGN RELATIONS BENEFITS FROM US CIVIL SPACE ACTIVITIES. AN ACTIVE PROGRAM OF INTERNATIONAL COOPERATION IN VARIOUS SPACE-RELATED FIELDS WILL CONTINUE TO CHARACTERIZE THE US APPROACH TO THE USE AND EXPLORATION OF OUTER SPACE.

A DRAMATIC EXAMPLE OF THE US COMMITMENT TO INTERNATIONAL COOPERATION IN SPACE IS THE MANNED SPACE STATION PROGRAM ANNOUNCED BY THE PRESIDENT IN HIS STATE OF THE UNION ADDRESS. THIS IS A MAJOR NEW AND FAR-REACHING INITIATIVE CALLING FOR INTERNATIONAL PARTICIPATION IN A VERY LARGE, LONG-TERM AND COMPLEX PROJECT WHICH WILL EMPLOY THE LATEST DEVELOPMENTS, IN SPACE TECHNOLOGY. THE INTERNATIONAL ARRANGEMENTS MAY BE DIFFICULT AND WILL CERTAINLY REQUIRE IMAGINATION AND INITIATIVE. WE WILL BE TRAVELING AN UNCHARTED COURSE AND MUST WORK OUT ARRANGEMENTS WITH FEW IF ANY PRECEDENTS TO GUIDE US. THE DEPARTMENT OF STATE WILL WORK CLOSELY WITH NASA AND OTHER INTERESTED AGENCIES TO MAKE THIS PROGRAM A SUCCESS: ONE THAT WILL PROMOTE US FOREIGN POLICY INTERESTS. WE ARE CONFIDENT THAT, IN THE LONG RUN, THE MANNED SPACE STATION PROJECT CAN HAVE FAR-REACHING BENEFITS TO OUR PARTNERS AND TO OURSELVES. WE, FOR EXAMPLE, EXPECT TO BENEFIT FROM THE SCIENTIFIC AND FINANCIAL CONTRIBUTIONS THAT OUR ALLIES WILL MAKE TO THE PROGRAM. OUR ALLIES AND OTHER NATIONS HAVE WELCOMED THE SPACE STATION PROGRAM BECAUSE IT PROVIDES THE OPPORTUNITY FOR CREATING NEW COOPERATIVE ARRANGEMENTS IN THE SPACE FIELD AND

BECAUSE IT ONCE AGAIN CLEARLY PUTS THE UNITED STATES AND THE WEST IN THE FOREFRONT OF SPACE DEVELOPMENTS.

WE MUST ALSO CONSIDER THE OTHER SIDE OF THE COIN: THE UNITED STATES TODAY FACES, IN ADDITION TO THE OPPORTUNITIES FOR COOPERATION, THE CHALLENGES OF COMPETITION AS WELL. LEADERSHIP IN SPACE IS STILL A FACTOR IN THE POLITICAL COMPETITION BETWEEN THE UNITED STATES AND THE SOVIET UNION. WHILE THIS ASPECT OF EAST-WEST RIVALRY HAS DIMINISHED SOMEWHAT SINCE THE 1960'S, IT CAN STILL CATCH THE IMAGINATION OF PEOPLE AROUND THE WORLD. THE SPACE STATION PROGRAM PLACES THE UNITED STATES ON A SOLID FOOTING IN THIS RESPECT FOR FUTURE YEARS.

WE MUST ALSO CONSIDER THE FACTOR OF GROWING COMMERCIAL COMPETITION IN SPACE. THE UNITED STATES HAS RECENTLY TAKEN STEPS TO ENHANCE ITS INTERNATIONAL COMPETITIVE POSITION, THE MOST IMPORTANT OF WHICH ARE THE AUTHORIZATION AND ENCOURAGEMENT OF COMMERCIAL EXPENDABLE LAUNCH VEHICLES AND THE EXPANDED OPPORTUNITIES FOR COMMERCIAL REMOTE SENSING APPLICATIONS ANTICIPATED IN THE TRANSFER OF THE LANDSAT PROGRAM TO THE PRIVATE SECTOR. THE DEPARTMENT OF STATE HAS BEEN A STRONG SUPPORTER OF THESE STEPS, AND, IN COORDINATION WITH OTHER AGENCIES, WILL WORK TO CREATE AN INTERNATIONAL ENVIRONMENT IN WHICH US COMMERCIAL SPACE ACTIVITIES CAN EFFECTIVELY COMPETE.

THE PRINCIPAL ROLE OF THE DEPARTMENT OF STATE IN THE FIELD OF INTERNATIONAL CIVIL SPACE ACTIVITIES IS TO ATTEMPT TO HARMONIZE U.S. INTERNATIONAL OBJECTIVES AND INTERESTS, AND TO INTEGRATE THOSE INTERESTS INTO OUR OVERALL FOREIGN POLICY OBJECTIVES. WITHIN THE DEPARTMENT OF STATE, THE PRINCIPAL RESPONSIBILITY FOR THIS MISSION RESTS WITH THE OFFICE OF ADVANCED TECHNOLOGY, LOCATED IN THE BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS. I BELIEVE THAT THE DEPARTMENT OF STATE IS WELL-POSITIONED TO PROVIDE THE ESSENTIAL FOREIGN POLICY LEADERSHIP NECESSARY IN COMING MONTHS AND YEARS AS THE U.S. CONTINUES TO EXPAND ITS CIVIL AND PRIVATE SECTOR ACTIVITIES IN OUTER SPACE. WE ARE CONTINUING TO STRENGTHEN BOTH OUR RESOURCES AND EXPERTISE SO THAT WE MAY CONTINUE TO PARTICIPATE EFFECTIVELY IN EXISTING INTER-AGENCY MECHANISMS AND ANY ADDITIONAL INSTITUTIONAL ARRANGEMENTS THAT MAY BE DEVELOPED TO AUGMENT THE DEVELOPMENT OF POLICY IN THE FIELD OF CIVIL SPACE ACTIVITIES. FROM THE DEPARTMENT'S POINT OF VIEW, THE INTER-AGENCY MECHANISMS CURRENTLY IN PLACE ARE FUNCTIONING EFFECTIVELY. I WILL DESCRIBE THE DEPARTMENT'S ROLE IN THESE MECHANISMS AND THE PARTICULAR ROLE OF THE OFFICE OF ADVANCED TECHNOLOGY, IN GREATER DETAIL AT THE CONCLUSION OF MY STATEMENT.

OF SPECIAL IMPORTANCE TO THE DEPARTMENT OF STATE HAS BEEN U.S. PARTICIPATION IN MULTILATERAL INSTITUTIONS CONCERNED WITH OUTER SPACE ISSUES. FOREMOST AMONG THESE INSTITUTIONS HAS BEEN

THE UN COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE - COPUOS. I WAS HEAD OF THE U.S. DELEGATION TO THE MOST RECENT COPUOS MEETING AT VIENNA LAST MONTH, AND I WOULD LIKE TO SHARE WITH YOU MY IMPRESSIONS OF THE RESULTS OF THE MEETING AND TO DISCUSS THE QUESTION OF FUTURE PARTICIPATION BY THE U.S. IN THE COPUOS.

THE UNITED NATIONS COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE WAS ESTABLISHED BY THE UN GENERAL ASSEMBLY IN 1959 TO SERVE AS THE FOCAL POINT IN THE UNITED NATIONS FOR THE PROMOTION OF INTERNATIONAL COOPERATION IN THE USE AND EXPLORATION OF OUTER SPACE. THE COMMITTEE ESTABLISHED OVER A PERIOD OF TWENTY YEARS AN EXCELLENT RECORD AS A FORUM FOR THE EXCHANGE OF SCIENTIFIC INFORMATION AND FOR THE NEGOTIATION OF SEVERAL MAJOR TREATIES GOVERNING ACTIVITIES IN OUTER SPACE. WHETHER THE EFFECTIVENESS OF THIS COMMITTEE WILL CONTINUE, HOWEVER, IS NOW IN SERIOUS DOUBT.

IN RECENT YEARS, THERE HAS BEEN A SERIOUS DETERIORATION IN THE COMMITTEE'S SCIENTIFIC AND TECHNICAL FOCUS AND AN INCREASING TENDENCY OF THE COMMITTEE TO INVOLVE ITSELF IN DISARMAMENT AND OTHER MATTERS BEYOND THE SCOPE OF ITS COMPETENCE. MOREOVER, IN 1982 the 37TH GENERAL ASSEMBLY ADOPTED, BY VOTE, A RESOLUTION CONTAINING A SET OF DRAFT LEGAL PRINCIPLES GOVERNING DIRECT SATELLITE TELEVISION BROADCASTING, PRINCIPLES UPON WHICH CONSENSUS COULD NOT BE REACHED IN THE COPUOS AND TO WHICH THE UNITED STATES AND MOST OF ITS ALLIES WERE STRONGLY OPPOSED. DESPITE STRENUOUS EFFORTS BY THE UNITED

STATES AND OTHERS TO ACHIEVE A COMPROMISE, A GROUP OF 16 COUNTRIES DECIDED TO SEEK A VOTE. THIS DEVELOPMENT WAS THE FIRST SIGNIFICANT BREAK WITH THE LONGSTANDING UNITED NATIONS TRADITION OF DEALING WITH OUTER SPACE ISSUES ON A CONSENSUS BASIS ONLY.

THAT DEPARTURE FROM TRADITIONAL APPROACHES TO OUTER SPACE ISSUES WAS REPEATED AT THE 38TH GENERAL ASSEMBLY LAST YEAR WHEN, FOR THE FIRST TIME, THE ANNUAL OMNIBUS RESOLUTION SETTING THE COPUOS AGENDA FOR THE FOLLOWING YEAR WAS ADOPTED BY MAJORITY VOTE RATHER THAN CONSENSUS. THE PRINCIPAL REASON FOR THIS FAILURE OF CONSENSUS WAS THE INSISTENCE BY THE SOVIET UNION AND THE GROUP OF 77 COUNTRIES UPON THE INCLUSION OF OUTER SPACE DISARMAMENT ON THE COPUOS AGENDA, A MATTER THAT THE UNITED STATES AND ITS ALLIES FOUND IMPOSSIBLE TO ACCEPT INASMUCH AS THE GENEVA-BASED CONFERENCE ON DISARMAMENT IS THE SOLE APPROPRIATE MULTILATERAL FORUM FOR CONSIDERATION OF DISARMAMENT MATTERS, INCLUDING THOSE RELATING TO OUTER SPACE. THE RESOLUTION WAS ALSO OBJECTIONABLE TO THE UNITED STATES IN THAT IT CALLED FOR THE ESTABLISHMENT, WITHIN THE LEGAL SUBCOMMITTEE OF COPUOS, OF A WORKING GROUP ON THE QUESTION OF THE DEFINITION OR DELIMITATION OF OUTER SPACE AND ON DEVELOPING NEW LEGAL PRINCIPLES FOR UTILIZATION OF THE GEOSTATIONARY SATELLITE ORBIT, THE LATTER BEING AN AREA THAT IS THE PARTICULAR RESPONSIBILITY OF THE INTERNATIONAL TELECOMMUNICATION UNION.

THE UNITED STATES AND ITS ALLIES HAD LONG OPPOSED THE ESTABLISHMENT OF SUCH A WORKING GROUP.

FOLLOWING THE UNWELCOME TURN OF EVENTS AT THE 38TH UNGA, THE DEPARTMENT OF STATE AND OTHER AGENCIES OF THE EXECUTIVE BRANCH (ESPECIALLY NASA, DEFENSE, AND NOAA) GAVE VERY CAREFUL AND THOROUGH CONSIDERATION TO HOW OUR INTERNATIONAL SPACE-RELATED INTERESTS WERE AFFECTED AND WHAT OUR FUTURE RELATIONSHIP TO THE COPUOS SHOULD BE. NOTWITHSTANDING THE GENERALLY POOR STATE OF AFFAIRS IN THE COMMITTEE, AND AN UNDERSTANDABLE LACK OF ENTHUSIASM AMONG UNITED STATES GOVERNMENT TECHNICAL AGENCIES FOR PURSUING THEIR INTERESTS IN A FORUM WHICH HAD BECOME DEVOID OF MEANINGFUL SCIENTIFIC AND TECHNICAL WORK, THERE WAS AGREEMENT THAT WE SHOULD NOT TAKE ANY PRECIPITOUS ACTION, BUT SHOULD CONSIDER CAREFULLY HOW OUR LONG-TERM INTERESTS WOULD BE AFFECTED BY WITHDRAWING OR REMAINING INVOLVED IN THE COPUOS. AT THE SAME TIME, BUSINESS AS USUAL IN RESPECT TO US PARTICIPATION IN THE COMMITTEE, WAS FELT TO BE INAPPROPRIATE. WE DECIDED TO DEMONSTRATE OUR CONCERN OVER RECENT DEVELOPMENTS AND TO ACT IN A WAY WHICH MIGHT ALSO PRODUCE SOME POSITIVE CHANGES DURING THE MEETINGS OF COPUOS AND ITS SUB-COMMITTEES IN 1984. OUR ACTIONS HAVE BEEN CALCULATED TO MAKE CLEAR :

-- THAT WE ARE FULLY COMMITTED TO INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE, BUT THAT THE STERILE, CONFRONTATIONAL APPROACH OF BLOC POLITICS WHICH HAS CHARACTERIZED COPUOS IS INCONSISTENT WTIH SUCH COOPERATION;

-- THAT WE ARE EXAMINING WHAT OUR FUTURE RELATIONSHIP TO THE COPUOS SHOULD BE;

-- IN THE INTERIM, OUR PARTICIPATION IN THE COPUOS AND OUR SUPPORT FOR VARIOUS ACTIVITIES UNDER ITS AUSPICES WILL BE CONSIDERABLY LOWERED;

-- WE WILL BE PLEASED TO WORK WITH THOSE COUNTRIES WHICH ARE WILLING TO SEEK MORE CONSTRUCTIVE WAYS OF DOING BUSINESS IN THE COMMITTEE, AND TO CONSIDER WHAT THE COPUOS' PROPER BUSINESS SHOULD BE.

WE HAVE WORKED VERY CLOSELY WITH OUR ALLIES IN AN ATTEMPT TO RESTORE THE CONSENSUS PRINCIPLE AND TO RETURN THE COMMITTEE TO A BUSINESS-LIKE ATMOSPHERE. MOREOVER, WE UNDERTOOK A LOW-KEY, BUT INTENSIVE, DIPLOMATIC EFFORT IN FOREIGN CAPITALS AND WITH PERMANENT MISSIONS IN NEW YORK TO DRAW ATTENTION TO THE SERIOUS SITUATION IN COPUOS AND TO RE-DOUBLE OUR ATTEMPTS

AT FINDING COMMON GROUND ON THE ISSUES AND ON THE NATURE OF THE COMMITTEE'S WORK.

THE CYCLE OF COPUOS MEETINGS FOR 1984 HAS NOW RUN ITS COURSE AND, WHILE THERE IS A GREAT DEAL OF WORK THAT REMAINS TO BE DONE IN THE 39TH SESSION OF THE GENERAL ASSEMBLY THIS FALL, I CAN OFFER SOME IMPRESSIONS ON THE RESULTS TO DATE. I MUST INFORM YOU THAT, DESPITE OUR EFFORTS, AS WELL AS THOSE OF OUR ALLIES, THERE IS LITTLE ROOM FOR OPTIMISM REGARDING THE FUTURE USEFULNESS OF THIS COMMITTEE. THE MAJORITY OF THE COPUOS' MEMBERSHIP APPEAR NOT TO SHARE THE CONCERNS OF THE UNITED STATES AND OTHER INDUSTRIALIZED NATIONS REGARDING THE NEED TO EMPHASIZE SCIENTIFIC AND TECHNICAL ISSUES IN THE COMMITTEE AND TO RESTORE THE CONSENSUS PRINCIPLE IN THE GENERAL ASSEMBLY'S CONSIDERATION OF THE COPUOS' WORK.

AT THE RECENT SESSION OF THE FULL COMMITTEE, THE AMOUNT OF TIME ON THE COPUOS' AGENDA FOR SCIENTIFIC AND TECHNICAL MATTERS WAS REDUCED BY FORTY PERCENT FROM THE 1983 SESSION, WHILE DISARMAMENT MATTERS PROVIDED THE PRINCIPAL FOCUS FOR DISCUSSION. A MODEST PROPOSAL FROM THE NETHERLANDS SIMPLY TO TALK ABOUT THE ORGANIZATION AND THE PROCESSES OF THE COMMITTEE WITH THE AIM OF RE-INVIGORATING ITS SCIENTIFIC AND TECHNICAL FOCUS HAS SO FAR BEEN REJECTED BY THE SOVIET UNION AND THE GROUP OF 77 DELEGATIONS. SIMILARLY, A VERY THOUGHTFUL PROPOSAL BY THE AUSTRALIAN CHAIRMAN OF THE COPUOS SCIENTIFIC AND

TECHNICAL SUB-COMMITTEE TO TAKE STOCK OF NEW GLOBAL SCIENTIFIC ISSUES RIPE FOR CONSIDERATION RECEIVED NO SUPPORT.

THE REPORT THAT WILL EMERGE FROM THE 1984 SESSION OF COPUOS WILL REFLECT FUNDAMENTAL DIFFERENCES OF OPINION ON NEARLY EVERY ITEM ON THE COPUOS' AGENDA, AND EVEN SOME THAT ARE NOT ON THE AGENDA (E.G. THE NEGOTIATION OF A NEW DIRECT BROADCAST SATELLITE TREATY FAVORED BY THE SOVIET UNION AND THE GROUP OF 77).

THERE IS LITTLE THAT IS UNIQUE ABOUT OUR PROBLEMS HERE; THE COPUOS WAS ESTABLISHED BY THE UNGA AND AS ITS MEMBERSHIP HAS GROWN (FROM 24 IN 1959 TO THE PRESENT 53) IT HAS COME TO REFLECT SOME OF THE GENERAL ASSEMBLY'S MORE BOTHERSOME TRAITS. DEBATES ARE MORE AND MORE MARKED BY BLOC POLITICS AND A BREAKDOWN IN CONSENSUS. WITH THE EXCEPTION OF A HANDFUL OF COUNTRIES, REPRESENTATIVES TO COPUOS MEETINGS FREQUENTLY LACK SCIENTIFIC OR TECHNICAL QUALIFICATIONS, A SITUATION THAT WAS NOT TRUE OF THIS COMMITTEE DURING ITS MOST PRODUCTIVE YEARS.

FROM THE PARTICULAR POINT OF VIEW OF THE DEPARTMENT OF STATE, THE DEGENERATION OF THE COPUOS HAS BEEN ESPECIALLY TROUBLESOME, COMING AS IT DOES IN A PERIOD IN WHICH THE UNITED STATES ENVISAGES A SUBSTANTIAL EXPANSION IN ITS INTERNATIONAL SPACE-RELATED ACTIVITIES, NOT THE LEAST OF WHICH IS THE MANNED SPACE STATION PROGRAM, BUT INCLUDING, AS WELL, EXPANDED COMMERCIAL INVOLVEMENT RELATING TO LAUNCH VEHICLES AND REMOTE SENSING SATELLITES. WHILE THE MAIN ELEMENTS OF US COOPERATIVE ACTIVITIES IN OUTER SPACE HAVE ALWAYS BEEN CONDUCTED ON A

BILATERAL BASIS, THE DEPARTMENT OF STATE HAS FELT THAT MULTILATERAL COOPERATION IS IMPORTANT, THAT THE UNITED NATIONS HAS A SIGNIFICANT ROLE TO PLAY IN THIS FIELD, AND THAT THIS COMMITTEE IN PARTICULAR HAS BEEN A USEFUL FORUM FOR THE EXCHANGE OF SCIENTIFIC AND TECHNICAL INFORMATION AND THE DISCUSSION OF LEGAL ISSUES OF COMMON INTEREST.

IN THE PAST, US PARTICIPATION IN COPUOS HAS BEEN BENEFICIAL GENERALLY BY ENABLING THE US TO ENGAGE THE DEVELOPING COUNTRIES IN A CONSTRUCTIVE MANNER. UNFORTUNATELY, OTHER GOVERNMENTS APPARENTLY NO LONGER TAKE THE COPUOS' WORK AS SERIOUSLY AS THE UNITED STATES. IT IS WITH GENUINE REGRET THAT WE HAVE SEEN THE NATURE OF THE COMMITTEE AND THE CHARACTER OF ITS DELIBERATIONS DETERIORATE.

WE HAVE REACHED NO FINAL CONCLUSION ABOUT THE FUTURE ROLE OF THE UNITED STATES IN THIS COMMITTEE AND DO NOT EXPECT TO REACH ANY DECISION BEFORE THE END OF THE YEAR. IN THE MEANTIME, WE WILL CONTINUE TO TAKE PART IN THE UN DELIBERATIONS ON OUTER SPACE MATTERS AND WILL CONTINUE TO EXPLORE WAYS TO RETURN THE COMMITTEE TO ITS FORMER EFFECTIVENESS WHICH CAN ENCOURAGE AND CONTRIBUTE TO INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF OUTER SPACE.

BEFORE CONCLUDING MY PREPARED STATEMENT, AND ANSWERING ANY QUESTIONS YOU MAY HAVE, I WOULD LIKE TO OUTLINE VERY BRIEFLY THE RESPONSIBILITIES AND FUNCTIONS OF THE OFFICE OF ADVANCED TECHNOLOGY; I KNOW THAT THE ORGANIZATIONAL AND INSTITUTIONAL

ARRANGEMENTS FOR POLICY IN THIS FIELD ARE OF INTEREST TO THIS SUB-COMMITTEE AND ARE TREATED IN THE OTA DRAFT REPORT.

MY OFFICE DEVELOPS AND NEGOTIATES, IN COORDINATION WITH THE INTERESTED U.S. AGENCIES, AGREEMENTS FOR COOPERATIVE SPACE ACTIVITIES IN AREAS SUCH AS SPACE SCIENCE AND SPACE APPLICATIONS; SUPPORTS THE U.S. SPACE SHUTTLE PROGRAM BY ASSISTING NASA IN COORDINATING LAUNCH AGREEMENTS, DEVELOPING SHUTTLE CONTINGENCY LANDING SITE AGREEMENTS AND FOREIGN ASTRONAUT PARTICIPATION IN SHUTTLE MISSIONS;

WE ALSO CHAIR AN INTERAGENCY WORKING GROUP ON CIVIL SPACE HARDWARE/TECHNOLOGY TRANSFER AS REQUIRED BY PRESIDENTIAL DIRECTIVES AND REVIEW AND ADVISE THE DEPARTMENT'S OFFICE OF MUNITIONS CONTROL ON APPLICATIONS FOR THE EXPORT OF SPACE HARDWARE, MISSILE AND RELATED ADVANCED TECHNOLOGIES.

ADDITIONALLY, THE OFFICE OF ADVANCED TECHNOLOGY SUPPORTS BOTH THE UNDERSECRETARY FOR SECURITY ASSISTANCE, SCIENCE AND TECHNOLOGY AND THE ASSISTANT SECRETARY FOR OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS IN REPRESENTATION OF THE DEPARTMENT ON THE SENIOR INTERAGENCY GROUP AND INTERAGENCY GROUP ON SPACE. THE PRESIDENTIALLY-DIRECTED, NSC-LED ACTIVITIES INCLUDE NATIONAL STUDIES ON SPACE STRATEGY, SPACE TRANSPORTATION SYSTEMS, THE SPACE STATION, EXPENDABLE LAUNCH VEHICLE COMMERCIALIZATION, AND OTHER MATTERS.

MY OFFICE IS DIRECTLY RESPONSIBLE FOR U.S. REPRESENTATION IN THE OECD'S COMMITTEE ON SCIENCE AND TECHNOLOGY POLICY

WHICH IS INVOLVED IN THE STUDY OF HIGH TECHNOLOGY TRADE, INCLUDING SPACE RELATED SERVICES, A HIGH PRIORITY ISSUE TO THE U.S., AND FOR U.S. REPRESENTATION IN THE NATO SCIENCE COMMITTEE, AN IMPORTANT MECHANISM FOR INCREASING SCIENTIFIC COOPERATION AMONG NATO NATIONS.

WE PROVIDE STAFF SUPPORT TO THE WHITE HOUSE IN OVERSEEING THE IMPLEMENTATION OF COOPERATIVE SCIENCE AND TECHNOLOGY PROJECTS AGREED UPON AT ECONOMIC SUMMITS. MY OFFICE WILL SERVE AS THE COORDINATOR IN THE DEPARTMENT OF STATE FOR INTERNATIONAL NEGOTIATIONS RELATING TO FOREIGN PARTICIPATION IN THE SPACE STATION.

THANK YOU MR. CHAIRMAN.

United States Department of State

Washington, D.C. 20520

OCT 18

Dear Mr. Chairman:

I refer to your letter dated July 27, 1984 in which you forwarded additional questions relating to Mr. Otho Eskin's testimony on July 25, 1984 at the Subcommittee's hearings on international cooperation and competition in space.

Enclosed herewith are the Department's answers to those questions.

Sincerely,

W. Tapley Bennett

W. Tapley Bennett, Jr.
Assistant Secretary
Legislative and Intergovernmental Affairs

Enclosure:
As stated

The Honorable
Harold L. Volkmer, Chairman,
Subcommittee on Space Science
and Applications,
Committee on Science and Technology,
House of Representatives.

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

HEARING ON INTERNATIONAL COOPERATION AND COMPETITION IN SPACE

July 25, 1984

Additional Questions for Mr. Eskin

1. Can you elaborate from your statement on how the Department of State will be participating with NASA and other agencies on the space station?

    a. How would you characterize your current working relationships in this regard?

    b. What mechanisms are utilized to coordinate with other agencies. Informal? Formal?

    c. Given the complexity of the space station program, are formal mechanisms necessary?

The Department of State intends to play a major role in the international negotiations of all arrangements or agreements, whether multilateral or bilateral, relating to foreign participation in the space station. This means broadly, involvement of Department or Embassy officers in all discussions with foreign government officials as well as the planning and preparation for those talks and the preparation of the actual documents. The current working relationships between the Department and NASA are quite good; the Department has every reason to believe that its foreign policy guidance in the space station program is welcomed by NASA. Department officers who work closely with NASA on various outer space-related issues have a very high regard for that agency's mission.

There are primarily two formal inter-agency mechanisms which have been involved in the development to date of the space station program: the Senior Interagency Group (Space) and the Interagency Group (Space), both of which include representatives from State, Defense, Commerce, OMB, CIA, JCS, ACDA, OSTP, and NASA. From time to time various inter-agency working groups have also been established to address particular subjects more intensively, as was the case in respect to the space station, and there are very solid and productive informal working relationships among those departments and agencies represented on the SIG(Space) and the IG(Space). The Department believes that the existing mechanisms in the Executive Branch are adequate to harmonize the interests of the interested agencies.

2. Your statement indicates you believe the Department of State has the foreign policy leadership necessary to expand civil and private sector activities in space. The OTA study recommends that the Department of State build up its expertise in space matters. Do you believe the State Department has sufficient expertise in space?

As indicated in Mr. Eskin's statement the Department is seeking to increase the staff of the Office of Advanced Technology, within the Bureau of Oceans and International Environmental and Scientific Affairs, and will be looking for personnel with primarily technical backgrounds, particularly in the space field. At the same time, the Department believes that it is adequately staffed to provide the essential foreign policy leadership in this area.

3. The OTA report stresses the need for long-term planning and the value of using space technology to support U.S. foreign policy. How is the State Department preparing to meet possible future conflicts in the UN and other international organizations regarding space technology?

The Department has felt that our long-term objectives in respect to consideration of outer space issues in the United Nations are best served by concentrating our present efforts on seeking to assure an environment where issues of mutual scientific or legal interest can be considered on their merits. This is a central concern in relation to the U.N. Committee on the Peaceful Uses of Outer Space where we have focussed our efforts on maintaining the scientific and technical antecedants of the committee while vigorously opposing the drift toward politicization and the breakdown of consensus.

4. What steps is the Department of State taking to return COPUOS to its former effectiveness?

The Department has undertaken a fairly intensive diplomatic effort during 1984 to once again make the COPUOS function effectively as the focal point in the United Nations for international cooperation in the use and exploration of outer space. In addition to wide-ranging talks with other member states during and on the margins of the meetings of COPUOS and its two sub-committees in 1984, these efforts have included extensive discussions in foreign capitals, with local embassy officials in Washington, and with representatives of permanent missions to the United Nations in New York.

A special attempt has been made, as well, to work very closely with our allies and other western governments to coordinate our efforts in finding solutions to the problems of COPUOS. Despite the absence of concrete progress to date, these diplomatic efforts will continue preparatory to and throughout the 39th Session of the U.N. General Assembly.

5. What mechanisms does the State Department use to involve the U.S. private sector in planning for and participating in space-related meetings of international organizations?

Because of the serious politicization affecting COPUOS (which is currently the central international forum for outer space discussions) and the current absence of serious scientific and technical work in the committee, as described in Mr. Eskin's statement, direct U.S. participation in recent COPUOS meetings has been essentially limited to diplomatic personnel. If our efforts to return COPUOS to a businesslike, technical forum succeed, the complexion of U.S. participation would change accordingly to emphasize, as we have in the past, representation from U.S.G. technical agencies. Naturally, the Department and those other agencies would expect in appropriate areas to rely heavily on the advice and assistance of the private sector, particularly as private investment in the use and exploration of outer space grows and U.S. private interests become increasingly pronounced.

6. In view of the dismal picture you paint for the future of COPUOS, can you suggest an alternate international forum for resolving international space-related activities?

(The Department feels that this question was addressed sufficiently in Mr. Eskin's testimony)

7. We are aware that a major concern of our international allies on space station cooperation is the assurance of U.S. commitment on the program.

    a. Is the Department of State looking into how the U.S. might substantiate its commitments?

    b. What, in your view, are the major concerns of our international partners on space station cooperation?

The Department is considering with NASA the form and extent by which commitments made on all sides should be substantiated. Inasmuch as the precise level and nature of commitments by us, as well as by our allies, remain to be ironed-out the Department feels it would be premature to come to conclusions about how they might be substantiated. For the same reason, the Department would hesitate to speak to what our Allies might present in the course of negotiations as their major concerns or requirements.

8. How does reduced U.S. participation in the UN Committee on the Peaceful Uses of Outer Space affect the efforts of the private sector to market space-related goods and services in developing and newly industrialized countries?

The Department has been monitoring this question very carefully; our conclusion to date is that the approach taken by representatives of certain Group of 77 states in COPUOS, seems to have very little to do with the rather extensive dealings developing countries have on a bilateral basis with U.S.G. technical agencies and U.S. commercial suppliers of space-related goods and services.

STATEMENT OF JOHN H. McELROY, ASSISTANT ADMINISTRATOR FOR ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICES, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Mr. VOLKMER. Dr. McElroy.

Mr. McELROY. Thank you, Mr. Chairman. With your permission, I will simply summarize my statement.

Mr. VOLKMER. Yes.

Mr. McELROY. The National Oceanic and Atmospheric Administration is clearly an agency with global interests in the atmosphere and ocean. This inevitably leads us into numerous areas of international cooperation which are quite important in our program.

I think that echoing Dr. Pedersen's comment, it is certainly true that successful international cooperation involves sharing both the funding of programs but also sharing the burden of funding those programs and sharing the responsibilities in carrying them out.

We believe that the NOAA activities meet those criteria quite well.

NOAA's space-related international activities can be divided into a number of areas, and I will simply touch upon those as I go through.

The principal one which has received a great deal of attention in the past is the exchange of weather data within the U.N. system run by the World Meterological Organization which exchanges both terrestrial measurements, conventional measurements, as well as satellite measurements.

In addition to the WMO activities, however, there's an extensive international program in producing their own weather satellites.

As of this date, there are four international satellites—four foreign satellites, I should say—and four U.S. satellites. So the international burden has already begun to grow beyond that of the United States.

In the future, it looks as if two additional countries, the Soviet Union and the People's Republic of China, will be adding geostationary weather satellites as well. That would lead to a total weather satellite complement (based on the current 2 polar U.S. systems) of some 10 weather satellites, 4 of which would be maintained by the United States. If the United States drops back to a single polar orbiter, of course, that would mean three out of nine.

So the international intent is there, it is serious, they are capable, and they are forthcoming in contributing to the international exchange of weather data.

With regard to terrestrial data, I will simply point out that in conventional measurements on a daily basis, the international community provides something like three times the number of conventional measurements that the United States does into the—the global exchange network.

In our own polar orbiters, there's also a trend occurring, which I think is quite significant in the area of international cooperation. That is the trend of increased participation in supplying hardware for flight on our spacecraft.

In the past, the United Kingdom has provided the stratospheric sounding unit, an operational remote sensing device on the polar orbiting weather satellites.

The French have provided the ARGO system. The French and the Canadians have provided the search and rescue hardware on those satellites. We have now, through the economic summit process, opened a dialog with them to increase their participation even further.

The United Kingdom has been extraordinarily forthcoming and has come forward and gotten approval to proceed with a new advanced microwave sounding unit which will be included in future polar-orbiting satellites.

Canada has come forward and begun the discussion of providing a global ozone measuring instrument. And last week, I received a letter from Italy in which they would like to investigate providing a microwave instrument.

So in the economic summit context, the attempt to provide an international polar orbiter is moving forward, although perhaps not as fast as any of us would like to see.

One of the issues which all of us are quite concerned about is obviously the cost of maintaining the weather satellite system. Certainly the prices of aerospace hardware have grown more rapidly than the Consumer Price Index, and are a source of continuing concern to us.

This morning's discussion with regard to shuttle pricing policy is obviously one in which NOAA shares the concern that has been expressed here. As a rather small user agency, however, let me make one point with regard to launch service prices.

There are two sets of industries that, and users, that we are trying to facilitate in all of our activities in the government. One is a set of users which employ space techniques, and one is another set of—of contributors who make space techniques available to those users.

In each case there are primary economic benefits to the economies: secondary and tertiary benefits. If you look at the providers of services, providers of infrastructure, such as launch vehicles, we can make those folks very healthy by increasing the prices of services. At the same time, however, the other half of that equation, we can make the users of space services quite poor; and, indeed, we may kill the goose that laid the golden egg. I don't expect that to happen but there is a—a tension or a balance there which must certainly be considered.

If we look at the future, we see that our partners are certainly proceeding with—with ambition, and skill, in moving out to provide space systems of their own.

We are providing a variety of forums in which we coordinate those activities to make sure that the total set of missions is coordinated in such a way that we derive the maximum possible benefits.

Two of those committees are deserving of notice here. One is the Committee called the Coordination on Geostationary Meteorological Satellites that coordinates the geostationary ring. That Committee has just met and meets—will meet again next year to continue to coordinate sensor and data collection system parameters.

In addition to that, there's a new Committee which coalesce by way of creating some efficiencies in committee structures, that all of the accumulated advisory committees and international committees on Earth—observations. This Committee will meet for the first time this year, early this fall.

One last point which will fall under that Committee's jurisdiction that I think is worthy of special notice is coordination of ocean satellite activities.

I would point out to the Committee that in the next 6 years a $1 billion investment is going to be made internationally in ocean satellites. I think it is mandatory for the benefit of the civil maritime communities in all our countries that we make sure that those missions not only produce useful data but coordinated data that the maritime community can benefit from.

These satellites were conceived domestically. Certainly we have the NASA missions both jointly with the Navy as well as the TOPEX mission which has been proposed. Internationally, we have the Europeans ERS-1 satellite. We have the Japanese MOS satellite. We have Canada's Radarsat. That is a significant major international investment worthy of very, very serious coordination activities.

NOAA is not an assistance agency, obviously, so the international cooperation activities that we carry out are those which facilitate the mission of NOAA. We are, however, tasked by assistance agencies to provide our expertise to support their efforts. One such example is the support we provide to the Agency for International Development in drought impact assessment.

We have just completed a very successful series of training programs in South and Southeast Asia to assist those countries in using both satellite and conventional data more effectively.

Dr. Pedersen mentioned in his statement that the—there is a NOAA role in the search and rescue program, the so-called COSPAS-SARSAT system. As we prepare for the future, we would see a transition occurring between the experimental role which NASA has so ably carried out, over to an operational role in the continuing flight of those instruments on NOAA's polar-orbiting satellites.

The last area of cooperation which is one which I will not dwell on, and that is in the area of Landsat. Clearly, we have first with NASA and now with NOAA, a series of MOU's [memoranda of understanding] with foreign governments to provide readout of Landsat data. Those have been incorporated and considered in the legislation which the Congress has passed and the President has signed. I am sure that the Congress is going to receive many briefings on Landsat. And I will stop my presentation here.

[The prepared statement of Mr. McElroy plus answers to questions submitted to Dr. McElroy for the record follow:]

STATEMENT
OF
JOHN H. McELROY
ASSISTANT ADMINISTRATOR FOR ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

JULY 25, 1984

Mr. Chairman and Members of the Subcommittee:

I am pleased to be here today to testify on the subject of international cooperation and competition in space activities. My testimony will stress the former.

The National Oceanic and Atmospheric Administration's (NOAA) satellite and information programs contribute to international cooperation. Our international partners play an important role, and our programs reflect their assistance. I believe that it is generally recognized that successful international programs involve sharing both benefits and responsibilities. The NOAA activities meet that criterion.

NOAA's space-related international activities can be divided into the following categories:

- o Exchange of weather data
- o Polar orbiters -- internationally-provided instruments
- o Coordination of satellite system planning
- o Coordination of ocean satellite activities

- Assistance in drought impact assessments
- Satellite-aided search and rescue
- Landsat

I will review our efforts in each of these categories.

Exchange of Weather Data

There is a longstanding and humanitarian practice that the nations of the world exchange weather data freely. No nation can forecast its weather using data acquired only within its national boundaries, as all nations' weather patterns originate outside their boundaries. Therefore, a variety of means have been developed for the exchange of weather data. They include terrestrial communication circuits and the direct broadcast of data from satellites.

Data are exchanged over the Global Telecommunications System (GTS) of the United Nations' World Meteorological Organization (WMO). These data include both satellite and conventional measurements. The United States is both a contributor and a major beneficiary of this system. In addition to the GTS, countries other than the United States provide weather satellites that broadcast data to many countries. They include Japan, India, the U.S.S.R., and Europe's EUMETSAT organization. Data from these satellites are used operationally by a number of U.S. agencies.

Polar Orbiters -- Internationally-Provided Instruments

Japan, the European Space Agency (ESA), and India have all elected to build and operate geostationary weather satellites, but only the U.S. -- other than the U.S.S.R. -- has funded polar orbiting weather satellites. Unlike the U.S. geostationary weather satellites, these foreign satellites provide only imagery data and are not scheduled to include sounding instruments. Therefore, the U.S. polar orbiters provide atmospheric soundings for Europe, Japan, and other nations.

NOAA maintains two advanded Tiros-N polar-orbiting satellites. In conjunction with our other civil and defense weather satellites, one polar orbiter satisfies the U. S. meteorological data needs. The second provides additional information and data for the United States as well as other countries. The cost of polar orbiters, like the cost of aerospace equipment overall, is going up at a rate far exceeding the Consumer Price Index (CPI).

With these increased costs in mind, I have initiated discussions with our Summit partners to develop an international polar orbiter. A working group has been formed for this purpose following the London Summit. While we have not yet achieved this goal, the discussions have led to increased allied funding for instruments that fly on our satellites. The United Kingdom currently provides a stratospheric sounding unit. A data collection and platform location system is supplied by France. Canada and France contribute to the existing search and rescue system.

It should also be noted that one possible home for an international set of operational earth observation instruments could be the polar-orbiting platform of the National Aeronautics and Space Administration's (NASA) Space Station program. A properly designed platform--responsive to the user community's needs, and at the right altitude with cost-effective servicing--could be a powerful tool in operational earth observations. There are many facets of the polar platform which make it highly attractive as an international cooperative venture--both domestically and internationally.

Coordination of Satellite System Planning

Many countries have the capability to and are deploying space observation systems. It is in all countries' best interest to coordinate their activities to minimize duplication and maximize benefits. To this end, a number of informal committees have been formed in the past and two are currently active. They are called the Coordination of Geostationary Meteorological Satellites (CGMS) and the International Earth-Observations Satellite Committee (IEOSC).

CGMS - This committee meets annually to coordinate the activities of the providers of geostationary weather satellites. The current membership includes EUMETSAT (representing the European countries contributing to Meteosat), India, Japan, the U.S.S.R., the United States, and the WMO. The People's Republic of China may join soon. The purpose of the group is to coordinate data formats, sensor characteristics, and operational procedures.

IEOSC - This Committee will also meet annually--beginning in 1984--to coordinate the advance planning for satellites for land, ocean, and atmospheric sensing. It is the product of the merger of several previous committees that dealt with the discipline areas individually.

Coordination of Ocean Satellite Activities

I firmly believe that the next major application of space technology will be in the routine observation of the world's oceans. The past successes of the GEOS-3 and SEASAT have produced convincing proof of the value of ocean observations and have led to both domestic and international plans for follow-on missions. In the United States, NASA is planning to participate with the Navy in the Navy Remote Ocean Sensing System (NROSS) and to fly the TOPEX mission. Also in the United States, the Department of Defense (DOD) will fly the GEOSAT mission later this year. In other countries, Japan will fly an ocean mission in 1986, ESA has an approved program targeted at a late 1980's launch date, and Canada has begun detailed studies for a RADARSAT mission. When all of these missions are considered, as well as the instruments on the civil and defense weather satellites that have utility for ocean observation, the total international investment in ocean satellite observations for the next decade will exceed one billion dollars.

A major coordinating activity is focused on attaining the maximum net benefits from these missions. The current efforts are aimed at coordination of the European Satellite (ERS-1) and the Navy's NROSS. Simple coordination of orbits--with no change in instruments or other mission parameters or cost--converts the two-to-three-day global ocean coverage of either satellite individually to daily global ocean coverage from the coordinated sum of the two missions. NOAA, representing the interests of the U.S. Navy and the civil maritime community, continues to negotiate with ESA for the exchange of data. As of this date the situation looks very favorable. The fora of the IEOSC mentioned above and the annual Economic Summit are being used to encourage coordination of the other missions.

Assistance in Drought Impact Assessment

NOAA is very heavily involved in Agency for International Development (AID) funded programs to assist countries in the developing world on drought impact assessment. These efforts involve both conventional and satellite technologies, and are being pursued in Asia, Africa, and South America. In May of 1984, the Assessment and Information Services Center of NOAA conducted a special training course in climate assessment techniques for meteorologists, economists, statisticians, and agronomists from nine South and Southeast Asian countries. In keeping with our overall philosophy, the course was preceded by a meeting of key decision makers from each of the countries in which we asked for a firm national commitment to the program--as opposed to an approach where training would be made available but no process for follow-through utilization was in place. We also asked for people with very specific skills who were assigned to particular ministries, and who would be returning to those ministries to use the new skills in their jobs. Satellite data are already available in the region from the NOAA polar-orbiting system and we are providing training that enhances their utility and employs the satellite data for new applications--e.g., biomass assessments through use of the vegetation index.

Satellite-Aided Search and Rescue

In the mid-1970's NASA initiated an experimental program in satellite-aided search and rescue. From the outset the program has been international in every respect--from the manufacture of space and ground system hardware to the day-to-day operation of ground stations and rescue forces. The program is made up of two interoperable space segments. The SARSAT system flies on the U.S. polar-orbiting environmental satellites and includes equipment provided by Canada and France. The second segment is the COSPAS system which is provided by the U.S.S.R.

Landsat

The Landsat program was begun under NASA in the early 1970's and transferred to NOAA more than two years ago when it reached an operational stage. International participants in the Landsat program have built ground receiving stations and received data under first a Memorandum of Understanding with NASA and now with NOAA. A further transition is underway as our Department proceeds with the transfer of the Landsat program to the private sector. The Congress has been briefed on the private sector transfer and will be offered further information as it continues.

Conclusion

The above programs are only a fraction of the activities of NOAA in the international sector. More complete descriptions are available in our standard program summaries. NOAA is an agency with global interests and responsibilities in the oceans and atmosphere. This leads inevitably to cooperative international programs in space applications.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ASSISTANT ADMINISTRATOR FOR ENVIRONMENTAL SATELLITE,
DATA, AND INFORMATION SERVICES
Washington, DC 20230

E/ER1:LRS

AUG 2 1 1984

Honorable Harold Volkmer
Chairman, Subcommittee on Space
Science and Applications
Committee on Science and Technology
House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

In response to your letter of July 27, 1984, I am enclosing responses to the questions you sent. I appreciate the opportunity to appear before the Subcommittee.

Please let me know if you would like any further information.

Sincerely,

John H McElroy
John H. McElroy

Enclosure

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SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

HEARING ON INTERNATIONAL COOPERATION
AND COMPETITION IN SPACE

July 25, 1984

Additional Questions for Mr. McElroy

QUESTION

1. OTA presents three options for the polar-orbiting Metsats:

   1- Flying one polar orbiter;
   2- Continuing with two U.S. polar orbiters;
   3- Cooperating with other countries in a joint system.

   a. Can you elaborate on some of the advantages and disadvantages of a cooperative Metsat system?

   b. Last fall, NOAA stated in a report to this Subcommittee that a formal, international organization is not feasible in the immediate future. Your statement indicates you are initiating discussions to develop an international polar orbiter. Can you elaborate?

ANSWER

1a. Over the past ten years, there has been significant international cooperation in the NOAA Metsat program. The United Kingdom, France, and Canada have contributed satellite instruments for meteorological and environmental monitoring and search and rescue activities. Such cooperation has reduced U.S. system costs and provided instruments which otherwise might not have been available. This illustrates one of the primary advantages of a cooperative Metsat system. Cost-sharing eases the burden on the United States and helps to ensure continuity of satellite data. A cooperative Metsat system could be one in which there was one U.S. operated satellite, and one composed of foreign contributions and possibly some form of international management. A cooperative Metsat system promotes the benefits of satellite remote sensing worldwide, and provides access to environmental data and satellite technology supplied by other countries. However, the United States could lose a certain amount of control over the definition and operation of the system. Conflicting requirements would have to be taken into account among the partners. Depending on the arrangement, there would be the chance of some disadvantageous transfer of technology. However, if properly managed, we believe a cooperative system can be advantageous for all partners.

b. In the report entitled International Meteorological Satellite System: Issues and Options, the primary conclusion was that in the near-term a formal multilateral satellite organization is not feasible. Broad international support will be evolutionary. Since issuing that report, NOAA has made significant progress in laying the foundation for extensive foreign participation in the Metsat program. Under direction of the Economic Summit of Industrialized Nations, the International Polar-Orbiting Meteorological Satellite group (IPOMS) was established. IPOMS will examine mechanisms for international support (direct funding or in-kind contributions) for the polar-orbiting satellite system. Members of IPOMS are Canada, the Federal Republic of Germany (FRG), France, Italy, Japan, United Kingdom, United States, the European Communities, and the European Space Agency. Canada, the FRG, France, Italy, and the United Kingdom have already expressed an interest in contributing instruments. The first meeting of IPOMS will be in November 1984.

QUESTION

2. You have touched on the development of a polar-orbiting platform for use in operational earth observations as part of the space station program.

   a. Can you elaborate on this proposal?

   b. Has NOAA made such a proposal to NASA?

   c. What are the opportunities for international collaboration on such a platform?

ANSWER

2a. Attached is a preliminary paper prepared by NOAA/NESDIS describing possible earth observation missions for the polar-orbiting platform of the Space Station. A more detailed paper will be provided to the Subcommittee in about four weeks.

b. NOAA/NESDIS has not made any formal proposal to NASA regarding the polar-orbiting platform. We have, however, provided informally a technical description of NOAA/NESDIS's interest.

c. The same considerations for international participation in the polar-orbiting satellite system hold true for the polar-orbiting platform. In fact, one of the issues that will be addressed in IPOMS is the flight of meteorological instruments on the polar-orbiting platform. In Europe and Canada, there is discussion regarding cooperation in providing earth observation instruments for this component of the Space Station, as well.

QUESTION

3. What is NOAA's role in space station planning? Should NOAA's role be expanded in these activities.

ANSWER

3. NOAA/NESDIS is participating in space station planning. We have one person detailed to NASA's Space Station Commercialization Working Group and will have a representative at the Space Station Platform Workshop being held in Woods Hole, Massachusetts, in October. As plans for the Space Station become more defined, NOAA/NESDIS's role will change accordingly.

QUESTION

4. What mechanisms does NOAA use to coordinate with NASA and other agencies on this and other international activities?

ANSWER

4. NOAA/NESDIS has an International and Interagency Affairs Unit which has extensive informal interactions with NASA International Affairs Division and Program Office personnel. On a more formal basis, there are NASA-NOAA agreements defining cooperation in meteorological satellites and the transfer of Landsat to the private sector and periodic meetings take place under these agreements. In addition, the NASA European Representative works closely with NESDIS on European activities, and NESDIS provides some support for him for administrative services in connection with programs of mutual interest to NASA and NOAA. This relationship serves both NASA and NOAA, by providing a common interface between U.S. and European civil space activities.

In addition, NASA representatives have participated in multilateral remote sensing coordination activities and will be participating in our new multilateral groups, the International Earth Observations Satellite Committee

(IEOSC) and the International Polar-Orbiting Meteorological Satellite group (IPOMS), providing further coordination. In areas where both NASA and NOAA have common or compatible interests with a foreign partner, we provide NOAA observers at NASA meetings, and invite NASA observers at NOAA meetings with our foreign counterparts.

With other agencies, such as the Department of State, Interior Department, and others, we have similar continual informal contacts at the working level, and formal arrangements where the magnitude of the program requires. For instance, the Interagency Board on Civil Operational Earth Observations Satellite Systems (IB-COESS) has been used to discuss positions on foreign remote sensing activities.

QUESTION

5. Can you comment on the future of the SARSAT Search and Rescue program?

ANSWER

5. In October, a delegation from the U.S. will travel to Leningrad to meet with representatives from Canada, France, and the U.S.S.R. to discuss the COSPAS-SARSAT MOU (memorandum of understanding). Because NOAA will assume responsibility for the system in the future, NOAA is leading the interagency and international discussions leading toward extending operations until 1990.

QUESTION

6. As other nations expand and develop their space capabilities, how is this affecting NOAA priority setting on international cooperative activity?

ANSWER

6. NESDIS international cooperative activity priorities are determined by overall NOAA/NESDIS programmatic priorities. The final content of a NESDIS program may be affected by available foreign expertise and capabilities, but the priorities are determined initially by internal programmatic interests.

The increasing space capabilities of other nations provide us with increasing opportunities for cooperation which is in our interest. We can seek cooperation with foreign agencies as partners, and negotiate for larger foreign contributions to our programs. In addition, we can benefit from non-U.S. programs which produce data of direct interest and value to us. The European ERS-1 program is an example. We are discussing arrangements to have access to data from an entire satellite program for the cost of some modifications and operating expenses at our existing ground facilities without paying anything for the spacecraft and instruments themselves, or the spacecraft operating costs. By coordinating ERS-1 with the planned U.S. N-ROSS program, we are significantly increasing the utility of our own N-ROSS data as well, by providing daily, rather than every three days coverage.

QUESTION

7. Many of our international cooperative relationships have been shaped through governmental interaction. Today, we are seeing greater commercial use and privatization of space.

   a. How will this affect our international relationships?

   b. How can we foster the involvement of the private sector in shaping international cooperative activities in space?

ANSWER

7a. Domestic commercial activities create some challenges for our international relationships. There are concerns and sensitivities abroad about dealing with a commercial entity where traditionally there has been a government interface. However, we believe that through our established relationships we can provide information and assurances to our foreign counterparts and guidance to the U.S. commercial entities to minimize any concern. In the Landsat area, this process has begun with our providing periodic briefings and updates on commercialization activities. In the meteorological satellite arena, we are not undertaking any commercialization activities; so this is not a significant factor.

b. We are already using our international space cooperation as a mechanism for supporting U.S. aerospace industry export activities. For example, NESDIS recently participated in a commercial space technology exhibition in Zurich in cooperation with the U.S. Foreign Commercial Service, including chairing a one-day symposium on commercial remote sensing opportunities. This provided a forum for U.S. industry to present its capabilities to a wide European audience. We support the annual ERIM Symposium which is probably the most widely attended remote sensing event involving both the commercial and scientific communities. Furthermore, the indirect linkages provided to U.S. contractors by their contacts with our international partners represent access to potential markets for direct commercial activities.

QUESTION

8. Will NOAA be involved in implementing the President's policy on the commercial use of space?

ANSWER

8. We expect that NOAA will be the lead agency in the commercialization of civil land remote sensing satellites. In addition, NOAA will provide technical expertise to the Commerce Department in other commercial space activities.

May 14, 1984

PRELIMINARY THOUGHTS ON THE UTILITY OF THE SPACE STATION TO OPERATIONAL EARTH OBSERVATIONS

John H. McElroy

There are three principal elements to the Space Station Program: (1) the manned Space Station and its peripheral equipment in a low-altitude orbit at 28.5 degrees inclination, (2) a man-tended co-orbiting platform in the same orbit as the manned Space Station, and (3) a man-tended platform in near-polar sun-synchronous orbit at an altitude yet to be determined.

It is the third element of the Space Station complex, the polar platform, that will be the focus of this review. The other elements of the complex have no direct utility to NOAA's operational earth observations missions, although indirect utility might come from their use in research or in staging or servicing geostationary missions in the more distant future. The polar platform, on the other hand, may have considerable utility to operational earth observations, providing its characteristics are appropriately chosen and it proves to be a cost-effective means of carrying out the NOAA missions. Indeed, under the proper circumstances, the operational missions may provide the core justification for a polar platform, with an added justification being derived from the research missions. The fundamental reason for this statement is the matching of a permanent observational requirement to a permanent space capability.

To set the stage for the discussion, it is useful to enumerate some current trends in operational earth observations:

- Costs and complexity are increasing rapidly--e.g., weather satellites have grown in cost from $25 million per satellite (excluding launch costs) to a projected cost in excess of $100 million per satellite later in this decade.
- Earth observations satellites carry many instruments that serve many different user communities. The satellites are already multifunctional--e.g., the weather satellites carry instruments used for meteorological, oceanographic, and land measurements, a data collection system for environmental data, devices to monitor the solar-terrestrial environment, research instruments concerned with the Earth's climatology, and a search and rescue transponder. The satellites also carry internationally provided and funded hardware in a manner that is directly analogous to some NASA thoughts for the Space Station.
- Defining what determines the end-of-life for a mission--and therefore grounds for system replacement--is becoming increasingly difficult. Which user constituency, domestic or foreign, is to be denied service, if one instrument fails but others remain fully operational?

- A corollary to the last point, as well as to the first trend noted concerning increasing instrument costs, is that it seems less and less reasonable to discard adequately functioning subsystems and instruments just because other subsystems and instruments have failed. Current practice is dictated by a prioritization of observational needs overlayed on the highly variable and differing lifetime of the instruments and subsystems that make up a weather satellite or other earth observations satellite.

- Clusters or suites of instruments are required to produce the data required by many applications, and near-simultaneous measurements are often necessary from those instruments. Further, such instrument clusters are rarely applicable to a single discipline (land, weather, or ocean), but have multiple uses.

- Of the Space Station possibilities, the most useful orbit, indeed almost the only useful orbit for remote sensing, is the polar orbit. However, along the polar orbit there are a relatively few positions (defined by the equator crossing time) where it is most desirable to locate an instrument cluster. Two particular ones are 9:30 AM and 1:00 PM. They meet nearly all remote sensing needs.

- Manned missions to service, repair, or replace instruments appear to be feasible and useful--provided the servicing mission is found to be cost effective.

- Numerous experimental earth observations missions are planned by the United States and other nations. The expected success of these missions will create pressures from the user communities for a continuation of these measurements on an operational basis. This will lead to a desire for a cost-effective operational home for the instruments--the polar platform might provide that home.

- From the perspective of the operational system designer, the middle 1990's are here now; the 1990's are not the far-distant future. The instrument cluster that will be required in the 1990's is completely defined now. Indeed, it is technologically feasible to begin immediately the development of a man-tended polar platform of revolutionary earth remote sensing capability.

The above trends and observations lead to the conclusion that it is desirable to study the polar platform further with respect to its use by the operational remote sensing missions. In the next few paragraphs the operational requirements will be examined in a preliminary manner.

The first step is to state some general system requirements with respect to payload accommodations:

- Because of the long expected lifetime of the system--likely to extend over several generations of instruments--the interfaces with the payloads must be flexible and tolerant of the predictable improvements in sensor capabilities.

- The support subsystems must be highly reliable and redundant.
- High data-rate transmissions of global data must be provided through the Tracking and Data Relay Satellite (TDRS), but both high and low data-rate transmission must also be provided to ground stations to meet local needs and satisfy timeliness requirements.
- Two polar platforms are required (at the equator crossing times mentioned above), but one platform may consist of co-orbiting sections that are connected by microwave, optical, or cable links. The sections would co-orbit in adequately close proximity to one another so that they would appear as a single point source to ground tracking systems and so that a single servicing mission could readily visit both sections.
- The platform must accommodate passive radiative coolers for electro-optical detector cooling to cryogenic temperatures.
- The altitude of the platform must be commensurate with daily global coverage of the Earth by the appropriate sensor systems. There appears to be no doubt that the altitude will be considerably higher than that attainable by the Space Shuttle--leading to a major challenge in carrying out servicing of the platform.

At the 1:00 PM equator crossing time, the following instrument suite will be required. The heritage, applications, and approximate characteristics of each instrument will be described briefly.

1. Coarse Spatial-Resolution Multispectral Radiometer (CSMR) - The Advanced Very High Resolution Radiometer (AVHRR) carried on the current weather satellites, the Coastal Zone Color Scanner (CZCS) carried on Nimbus-7 and the follow-on Ocean Color Imager (OCI) flown on the Space Shuttle, and the sensor on the Heat Capacity Mapping Mission (HCMM) have all shown the great utility of precise radiometric measurements of the Earth at relatively coarse spatial resolution. Although the spatial resolution was coarse, the spectral and time resolution was high, particularly for the AVHRR.

   The radiometer will assume the role of all of the above sensors and provide data for weather forecasting, sea surface temperature measurements, marine productivity assessments, and vegetation assessments.

   The tentative characteristics include at least 10 visible, near, and far infrared bands and a spatial resolution between 500 and 1000 meters.

2. Advanced Microwave Imaging Sensor (AMIS) - This sensor is the expected successor to the Special Sensor Microwave Imaging (SSM/I) to be carried on the Defense Meteorological Satellite Program (DMSP) and the Navy Remote Ocean Sensing System (NROSS).

The SSM/I is a passive microwave radiometer that measures ocean surface wind speed (2 meters/second), ice edge (12.5 kilometers), and precipitation (5 millimeters/hour) all at a 25 kilometer spatial resolution or better. The advanced sensor would be an improved version with design changes based on flight experience.

3. Advanced Microwave Sounding Unit (AMSU) - This instrument has been under study for a number of years and is planned for flight on the NOAA-Next series of polar-orbiting weather satellites. It consists of two segments, one to be built by the United States and the second by the United Kingdom.

   The present operational sounding unit on the polar-orbiting weather satellites consists of three units: a High-Resolution Infrared Sounding System (HIRS-2), a four-channel Microwave Sounding Unit (MSU), and an infrared Stratospheric Sounding Unit (SSU). The AMSU will replace the MSU and SSU. It will provide temperature and humidity soundings even in the presence of total cloud cover.

   The AMSU will consist of two independent components. AMSU-A will consist of 15 channels in the 20-90 GHz range and will provide the data for the temperature sounding. AMSU-A will be built by the United States. AMSU-B will consist of 5 channels in the 90 to 183 GHz range. It will provide data for tropospheric humidity profiles, delineation of sea-ice and open water, and give an indication of soil moisture and snow thickness. AMSU-B is proposed to be built by the United Kingdom.

   An open question that must be resolved is whether the Advanced Microwave Imaging instrument and AMSU can be combined into a single device. They have been left as separate instruments for purposes of this discussion.

4. Infrared Sounding Unit (ISU) - The HIRS-2 infrared sounding instrument currently flown on the operational polar-orbiting weather satellites will continue into the 1990's as a cross-calibration source for the AMSU, for longwave radiation balance measurements, and as a backup infrared sounder for use in the event the AMSU should fail. This payload will also be used to test new infrared sounding concepts before their deployment on the geostationary system.

5. Radar Altimeter (RA) - Radar altimeters have been flown on Seasat and GEOS-3. They will be flown on the Navy's Geosat and NROSS, and the European Space Agency's ERS-1 satellite. NASA is also planning a high-precision altimeter mission called TOPEX. These experimental programs will lead to a need for continuing operational data.

   The altimeter will provide spacecraft altitude to nominally 8 cm or better and significant wave height data to a precision of nominally 0.5 meter. The data will provide geoid, wave, and ocean circulation information.

6. Precision Microwave Radiometer (PMR) - This sensor is a companion device to the Advanced Microwave Imager and AMSU. It is an outgrowth of the Scanning Multichannel Microwave Radiometer (SMMR) flown on Nimbus-7. The new sensor will be flown on the Navy NROSS, and consists of a two-channel instrument operating at 5 and 10 GHz. It will provide high-precision sea surface temperature maps, even in the presence of cloud cover, with a 1 degree temperature and a 2.5 kilometer spatial resolution.

   Sea surface temperature maps are needed by the civil and defense maritime communities to assist in ship routing, identification of promising fishing locations, and defense applications.

7. Radar Scatterometer (RS) - Such devices have been flown on Seasat and will be flown on NROSS and ERS-1. The instrument considered here is a direct outgrowth of the NROSS scatterometer. It's objective is the measurement of wind speed and direction, with a precision of 1.3 meters/second over a range of 4 to 26 meters/second in speed and 16 degrees in direction.

   The data are used for sea-state nowcasting and forecasting in support of the maritime community.

8. Global Ozone Sensor (GOS) - The Solar Backscatter Ultraviolet (SBUV) instrument will perform this measurement from the late 1980's into the early 1990's. This device is assumed to be a follow-on instrument to the SBUV, and discussions are under way with Canada for its development.

9. Earth Radiation Budget Instrument (ERBI) - This instrument will be the operational follow-on device to continue the monitoring of the Earth's net loss or gain of energy that was begun with the Earth Radiation Budget Satellite and its companion experiment on the NOAA polar orbiters (ERBS and ERBE, respectively).

10. Data Collection and Platform Location System (DCPLS) - One of the operational instruments carried on the polar-orbiting weather satellites is the data collection and platform location system called ARGOS, and provided by the French. This device will be the second generation ARGOS-II system.

11. Search and Rescue System (SRS) - This is another international program in which hardware is provided jointly by Canada, France, and the United States to detect the signals from emergency transmitters located on crashed aircraft or ships in distress.

12. Space Environment Monitor (SEM) - Another of the operational weather satellite instruments, the SEM detects solar events that may disrupt long-distance communication, electrical power transmission systems, oil and gas pipelines, or produce hazards to astronauts.

13. Direct Transmission Systems (DTS) - Many of the instruments provide data that are perishable, and which must be available in remote, local areas as soon as possible. For this reason, a wide variety of direct downlink and recording capabilities must be provided. These include such devices as Automatic Picture Transmission (APT), High Resolution Picture Transmission (HRPT), Direct Sounder Broadcast (DSB), and the transmission of oceanographic data to ships at sea. Recording systems are needed to back up the TDRS and ensure the collection of global environmental data for weather and sea-state forecasting. Although this function is not an instrument in the same sense as the others listed here, it poses special requirements on the sensors, data transmission system, and on-board processing capabilities of the platform.

14. Synthetic Aperture Radar (SAR) - Such radars were or will be flown on Seasat, ERS-1, and Canada's Radarsat. It will provide a spatial resolution of 25 meters over a 100 kilometer swath width. The antenna will be nominally 10 meters in length and 2 meters in width. The instrument will provide data on ocean waves, momentum and energy transport, and all-weather sea-ice imagery.

At the 9:30 AM equator crossing time, a very similar suite of instruments will be required. Instruments 1 through 7 and 10 through 14 will be required, plus one additional device:

15. Multilinear Array High-Resolution Imaging Sensor (MLA-HRIS) for Land and Coastal Applications - This device will be the follow-on instrument to the Thematic Mapper on Landsat-4 and -5 and the research on multilinear arrays currently being carried out by NASA. It is conceivable that this might also be a commercial instrument. It is expected that it would have enhanced spatial and spectral characteristics over those of the present Thematic Mapper. It is likely also to have off-nadir pointing capability analogous to that of the French SPOT system.

It can be seen that none of the above sensors is either speculative or even very imaginative. All that has been done is to assume that a number of missions that are currently under way (namely, the NOAA polar-orbiting weather satellites, NROSS, Europe's ERS-1, SPOT, and Landsat) will be successful and will stimulate a desire on the part of the user communities for the data to continue. Every sensor listed can be individually justified, although the most economical construction may lead to their combination into a fewer number of instruments. All can benefit from on-orbit servicing. The sensors can be provided by NOAA, NASA, DoD, foreign governments, or commercial firms. Further, if the capacity of the platform is great enough, around the core set of operational instruments a wide variety of research and experimental sensors could be deployed to provide correlative data, test new concepts, or make completely unrelated measurments.

The above very preliminary discussion seems to be a plausible starting point for an incisive and substantive examination of one of the key Space Station elements, the polar platform.

Mr. VOLKMER. Thank you very much. The gentleman from Florida. Do you have any questions of any of the witnesses?

Mr. MACKAY. I'm interested in the comment that Dr. McElroy has made concerning the transfer of the Landsat program to the private sector. I'd like to ask what is the status of that transfer?

Mr. MCELROY. Sir, I'm not a part of the transfer process. I only have the operational responsibility. There is a special group, which, in order to maintain the integrity of that process, reports directly to the Secretary of Commerce. So I have no firsthand information on this.

Mr. MACKAY. I see. All right.

I would be interested in a further discussion of the COPUOS and how that seems to be working itself out. Is this an issue between the developed and the developing nations? You gave examples of The Netherlands and Australia making what seemed to be sensible proposals which became very polarized in the discussions. If we are not going to be part of that, are the other industrialized nations sharing our view of it or is this a singular view?

Mr. ESKIN. In the first place, I don't see the issue as basically being a north-south polarization issue. I think—now, our experience has been that in practical bilateral cooperation with the developing countries, we don't have any of these, what I might characterize as ideological differences at all; our bilateral cooperation is quite effective.

The problem is with the committee itself and how it sees its business as being carried out.

Second, in this—we have a good many countries that have not only tacitly, but actively, supported us in our efforts. Many industrialized countries—particularly those countries with active space programs—share our concern about the deterioration in the committee, and have spoken up vigorously in the committee in the last few months, in an effort to try to turn around and put a stop to this—this drift which we all deplore.

Mr. MACKAY. Thank you, Mr. Chairman.

Mr. VOLKMER. If the gentleman will yield on that. I would like to inquire, we did not participate in the discussions in the COPUOS in Vienna on the question of disarmament, et cetera. Did any other nations not participate?

Mr. ESKIN. No, we were the only country to deliberately and ostentatiously make clear that our objection to inclusion of the—of disarmament as an agenda item was a very serious setback for the committee.

Other countries which shared that view and also objected to it, simply put their view, either were silent, or put that view on the record.

Mr. VOLKMER. My next question is, and if we were the only ones, what beneficial effect did that step that was taken have that you can see at this time, the one deliberation on COPUOS ?

Mr. ESKIN. Well, I wish I could tell you there was a beneficial effect. I think it's perhaps too early to say. Obviously, our position was a little bit different from anybody else. The issue that was being—that the committee, and some elements of the committee, wanted to discuss, was basically a moratorium on antisatellite weapons. An Indian proposal, which we just—which was in effect—

affected us as a delegation and as a country. So our role was somewhat different than that of certain other countries.

The reason that we made quite clear our objection, through the actions that we did, is that we felt that anything less than that would have been misconstrued, that the United States, despite its verbal protests at the last General Assembly, was in fact prepared to continue indefinitely on a business-as-usual basis in the committee, and we felt that it would be wrong to take our long-term position for granted. We felt we needed to do something to dramatize the seriousness of that. Whether that action will have a beneficial effect—it's too early to say.

Mr. **Volkmer**. It is the State Department's position then, that you can have military use of space as well as peaceful uses of space?

Mr. **Eskin**. Well, our position in terms of this Committee, was that we didn't want to discuss disarmament at all. There's a proper forum for that—the Conference for Disarmament in Geneva, in a multilateral context. And we deliberately did not get drawn into a discussion of any aspect of disarmament at the Committee. And I—the question that you've asked is beyond my scope of competence, so I would hesitate to respond.

Mr. **Volkmer**. Uh-huh. In the apparent at least discussion in your statement and here verbally too—it doesn't appear to me that if COPUOS continues on with the type of program and the type of methods used to determining the program and decisionmaking, that as far as our participation, doesn't appear to me to lead to positive ends, let's put it that way.

And do you have any suggestion as to any other space-related meetings of international organization where we could participate to continue on with multilateral type of agreements?

Mr. **Eskin**. Well, first, I would stress that we've made no final decision on COPUOS, and we continue to hope that there will be positive signs through our efforts during the next few months that we can see an improvement in COPUOS. And, therefore, we have made no decision or even discussions about an alternative to COPUOS.

I would only say as a way of generalization, that we would certainly not exclude the possibility that if COPUOS did not appear to be a useful form for multilateral coordination, consultation, we would look for other possibilities. I'm told that sometime ago, NASA arranged a kind of technical meeting at the Columbia University in New York, which I am told was a very successful meeting, and that we could look to that kind of ad hoc arrangement, perhaps, as guides and precedents, but we've made no decisions at all.

Mr. **Volkmer**. But those are basically involved countries that are already involved in space activities?

Mr. **Eskin**. Yes, although from our point of view, we would want to have multilateral cooperation to include as many countries as possible. We're not looking for some kind of exclusive club. In fact, one of the advantages of COPUOS is that it gave us an opportunity to meet on a regular basis with technical experts from developing countries. And that's still—we attach a lot of importance to that aspect in multilateral cooperation.

Mr. **Volkmer**. Is there any other areas of our foreign policy that may be influencing the 77 nations in their decisionmaking and deliberations within COPUOS ?

Mr. **Eskin**. It's hard to answer that question. It's clear from the record that many of the developing countries are—seem to be, for the moment, preoccupied with disarmament issues, and that is—had the unfortunate effect of eclipsing many of the other more—what we would consider more appropriate issues before the committee.

Beyond that, I can't speculate as to whether there are any other extraneous factors in their decisions.

Mr. **Volkmer**. How many personnel do you presently have within your office within the State Department?

Mr. **Eskin**. I think it's six.

Mr. **Volkmer**. Is that the total that's involved in space activities or space-related agreements, et cetera?

Mr. **Eskin**. No, there are—within the Department of State, we—there are a number of other bureaus that have varying degrees of responsibilities for space activities. The Bureau of Intelligence and Research, the Bureau of Political-Military Affairs, the geographic bureaus concerned with the direct bilateral relations with other countries, the Office of Telecommunications—there are a variety of offices and bureaus with whom we would deal directly—the Office of the Legal Adviser plays a major role in this area. So there are quite a lot of people.

Mr. **Volkmer**. Oh, I see where your position, then, your office, you have quite a few responsibilities. We didn't get into specific detail and perhaps we should with the Office of Technology Assessment, and the statement:

> The conduct of foreign policy is the responsibility of the Department of State, which has little expertise in space. If the United States wishes to use its civilian space activities to pursue U.S. foreign policy interests more aggressively, it will be important to expand the Department of State's expertise.

Do you wish to comment on that?

Mr. **Eskin**. Well, we could always use more expertise. And indeed, in my office we are seeking to increase the personnel and will be looking for the people with technical backgrounds, particularly in the space field.

But I would also add that given the limitations of resources that all of us in the Executive Branch operate under, we aren't going to try to duplicate the expertise that already exists in other agencies. We don't want to——

Mr. **Volkmer**. All right, let's put it this way: You state that in the event that we have international agreements with other nations, whether it's a multilateral, bilateral, on the space station, that you all would participate in the drafting of those agreements?

Mr. **Eskin**. I would anticipate doing so, yes.

Mr. **Volkmer**. And—and how many people within your office have expertise within the—the space technical fields, whether it's in engineering or physics.

Mr. **Eskin**. We have one pers—excuse me—we have one person now. We would hope to have four at such time as actual negotiations take place—I would hope to have two people with engineering or technical background.

Mr. Volkmer. Do you have anybody that's previously been involved with NASA?

Mr. Eskin. Yes, sir, we have one person——

Mr. Volkmer. You have one person?

Mr. Eskin. Yes, sir.

Mr. Volkmer. Do you feel that that's efficient?

Mr. Eskin. I would never want to say it's efficient but I would think it would be adequate. We are not going to try to, as I say, duplicate NASA's expertise. We——

Mr. Volkmer. No, I don't say you have to duplicate, but if you're going to participate in this type of decisionmaking and it gets down to policy, and I think that you should be—have people that are well acquainted with the actual technical aspects of them as well as policy decisions.

Mr. Eskin. I agree.

Mr. Volkmer. Mr. Pedersen, what does it appear—and I know we'll have the Administrator up next week—but what does it appear, from your viewpoint, as you see it at the present time, as possibility of participation of other nations, whether its USSR, Germany, or France, or Italy, or anybody else in the space station?

Mr. Pedersen. I think the prospect right now is good. Both Europe and Japan have taken some steps recently that tend to suggest to us that they are certainly prepared to proceed into the phase B study period with us. The European Space Agency Council, just some 2 weeks ago, approved in principle a European separate phase B look, definition studies, at what their participation in a space station would be. They will meet in the fall to carry out what amounts to their appr622orpriation phase, if the—what just happened might closely be analogized to the authorization that looks also promising. They are talking about approximately $80 million being used in their phase B process, split basically half between technology development and half to definition work. They are—I have indicated—they are shooting to begin their phase B work at about the time we are, the first of April or so, next year, so that they will be in parallel with us. So that—that appears promising.

The Japanese similarly have indicated their intent to go forward to their Diet this fall with a proposal. I note in the media and in talking with some of the Japanese officials that various industrial firms and so on in Japan have begun to—to set up study teams, and so forth.

These signs indicate that there's equal preparation there to engage themselves, and the same is true also in Canada.

So, I would say at least up to and through phase B the outlook is quite good. Of course, the major decision must come somewhat later on than right now; namely, the commitment to move forward into the C, D, and E phase where the large investments are involved. But on the basis that a long, and what will undoubtedly be complicated, journey, has to begin with some small steps. I think those small steps are indeed being taken.

Mr. Volkmer. How do you see the problem of technology transfer affecting, in the long run, the type of agreement that we would have, as far as participation by other nations?

Mr. Pedersen. Well, I think that——

Mr. Volkmer. You know, that the sort it cuts both ways.

Mr. **Pedersen**. Yeah, I was about to say that I think there's a certain amount of what I might want to term self-regulation at work here. That is to say, Europe and Japan have interests in terms of protecting their technology, their industry—industrial base as well. Indeed, the European decision to participate in space station was couched in terms of this, perhaps ultimately leading to an independent European space station capability. Japan has not stated that, but certainly they see it in terms of technology gains for them—for their industry.

This tends to suggest to me that all parties will come to the table with an interest not only in protecting their own technology but probably in investing and participating in a way in which their participation is fairly discrete and visible because there's an element of appearance here, an element of importance of having your own identifiable aspect to this. This would tend to support fairly discrete pieces which are developed independently with their own technology base, and with their own funds, which, of course, is a ground rule of our participatory approach, and they accept that and, indeed, support it. So that you are talking principally about interface questions we would anticipate during the development phase. So you are talking about being able to hopefully control technology to those things necessary to assure that you have well operating and smoother interfaces.

In the operational and utilization phase—and, Mr. Chairman, I would be remiss if I didn't mention that an important part of how we're approaching this is that we are indicating that they must not only have an interest in working with us to develop it, but also to utilize it. There, I think the main issues of technology are concerns of protection of proprietary data; protection of the results of the work they do up there, and so on.

These are going to be, I suspect, difficult questions, but ones that we have dealt with in one way or another in the past. For example, Spacelab raised many of the same issues. And we think that, at least initially, we've dealt rather well with that.

I think it will be an important issue. I think it's one about which there will be a lot of discussion, not only within the U.S. Government, but between the partners. A long history of cooperation and our discussions to date with our potential partners do not suggest that they are insoluble.

Mr. **Volkmer**. Would it suggest, though, that because of this, I'll say, difficulty and question of technology transfer, that we would, probably if we use a modular system, end up with various components being constructed by various countries, and not the whole thing constructed together by the large groups?

Mr. **Pedersen**. I——

Mr. **Volkmer**. Do you understand the difference, what I'm saying?

Mr. **Pedersen**. Yes, I understand the distinction.

I think it is quite clear in my mind and in the—by virtue of the discussions we've had with these countries, that an approach in which the space station, the overall space station, would be jointly designed, jointly engineered, and jointly developed, which I believe is the latter part——

Mr. **Volkmer**. Uh-huh.

Mr. **Pedersen** [continuing]. Of your question—would not be an approach that we would favor. And again, while you can find a full range of views expressed in Europe and in Japan, my sense is that that would not be the predominant preference of either of those countries as well.

Mr. **Volkmer**. You don't find their inclination to be toward that type of approach, then?

Mr. **Pedersen**. Again, I want to emphasize that you can find the full range of views, but my sense is that the predominant views in these countries are that they recognize, particularly in Europe, they recognize the importance of the technology transfer issue to them and to ourselves. Moreover, because for their own reasons, both technical and political, the importance of them emphasizing the capability to ultimately maintain their independence and move on—I think becoming deeply intertwined in our station in a way in which their participation becomes submerged, is probably not an approach that ultimately will prevail.

Mr. **Volkmer**. Uh-huh. I——

Mr. **Pedersen**. Again, I am—that's speculative on my part, and there is a broad range of opinion in Europe on this.

Mr. **Volkmer**. Mr. Pedersen, we've discussed here with Mr. Eskin the problems with COPUOS. Does NASA see any difficulties arising in the future in regard to international agreements, not only with space station but with other programs that we have ongoing, as a result of what's happening in COPUOS?

Mr. **Pedersen**. I don't believe so. I served in the role that Mr. Eskin recently served for several years. I might add, I—it was with great pleasure that I yielded the Chair of the U.S. delegation to Mr. Eskin, who carried out his duties admirably.

My experience has been, with regard to COPUOS, that there has been little, if any, direct linkage between the activities that went on there: the positions expressed, the speeches given, the rhetorical fights that frequently take place in various U.N. bodies, and the bilateral relationships with these various countries we maintained. Now, this is not to say that work of the COPUOS has done in the legal area, development of treaties and so on, obviously, that has had an effect, in almost all cases a good effect, in providing framework for us. But in terms of poisoning the well, so to speak, in a manner in which countries no longer wish to cooperate with us, or where they're—where we have not been able to find mutual benefit—I have not been able to establish much of direct linkage there at all.

I might say—I might speculate as to why that's the case, Mr. Chairman, if you would tolerate just 30 seconds more——

Mr. **Volkmer**. Yes.

Mr. **Pedersen**. And that basically is because even though it is the Committee on the Peaceful Uses of Outer Space, the vast majority of countries are represented by—they're represented by their permanent representatives at the United Nations or, in other words, diplomats, and not by space officials, or space technicians, with whom we deal and with whom our agreements frequently are made. There tends to base—the committee tends to be basically dominated by diplomats who then bring into the committee these broader political issues, which then do not directly affect our day-to-day business.

Mr. VOLKMER. OK. Dr. McElroy, you discussed very briefly the polar orbiters and the fact they were moving into the area of international provided instruments, and I wish to commend y'all for that.

Are we moving to the area where we could possibly have an international—truly international—weather system, where we presently have cooperative agreements and transfer of information, et cetera? But do you think that eventually, instead of NOAA doing it, we would have a international or global weather system run by, say, by international agreement by an international agency?

Mr. MCELROY. It is not inconceivable that that could be done over the long term. I think we're going through a period now where many countries have national space programs which they sustain for a variety of reasons besides the immediate benefits they derive from them—national pride—things of this sort.

I think as we go beyond that and the various countries begin to look very hard at those costs, then there's going to be a variety of pressures which are going to say, why shouldn't we buy common geostationary satellites, or something. Couldn't we get a better price if we did a joint buy of that sort?

If that pressure comes about, then that would pave the way toward such an international organization. I think the experience we're getting by having international contributions in the polar orbiters, having the coordination of data taking on the geostationary systems, is assisting us to get there.

I think if we announced today that we wanted to establish a new international organization, most people would react with a bit of horror; and they would want a little bit more impetus behind that before we moved into it. I think, though, in a decade——

Mr. VOLKMER. I agree that we've got a ways to go; there is that possibility that something could be done, but it's a long way off.

Are we going to go to one polar orbiter satellite?

Mr. MCELROY. As of this moment, we're still deeply enmeshed in our preparations of the 1986 budget. It's not at all clear what the administration position will finally be. I think if we take the consistency of the last couple of years, we're likely to come back here with a proposition rather like what we've done in the past; we may not, as well.

Mr. VOLKMER. Now, you touched on development of a polar-orbiting platform used as a space station. Could you elaborate a on this a little bit?

Mr. MCELROY. Yes, sir, I'd be glad to.

NASA's Space Station Program has three principal elements, as we understand it. One is a large manned core platform, a co-orbiting platform, which is in the same basic orbit as the manned platform.

And then there would be a polar platform, which is man-tended, but where people would not actually reside on the structure.

If you have a polar platform, which is a cost-effective vehicle for us to use—instead of buying our own, stand alone house, but to pay condo fees to get on board, it seems to me like that is a highly attractive spot for the operational mission to reside.

It seems to me that if we look at that—and it's designed in a way which is compatible with our interest—that the permanent presence in space sort of demands the requirement for permanent observations from space—that seems like a nice matchup for us.

So we are quite enthusiastic about NASA's Space Station Program. I have detailed a person to serve with the space station for us, to help provide our inputs. We have provided one preliminary document to them on our views on the polar platform. In 3 or 4 weeks we'll provide a more elaborate document of that same variety.

We find that the NASA people are quite responsive to our inputs but enthusiastic about hearing them. So I'm looking forward to that cooperation.

Mr. VOLKMER. So you're looking forward to continued—and I assume you—from that, you had a discussion and made a proposal, actually, so you will continue on with that discussions with NASA?

Mr. MCELROY. It doesn't constitute a firm proposal, but it's a technical document saying what we would like to see in the space station.

Mr. VOLKMER. All right. In other words, you'd let them know what you'd like to have?

Mr. MCELROY. Yes, sir.

Mr. VOLKMER. What's possible?

Mr. MCELROY. Yes, sir.

Mr. VOLKMER. Is there any area within that that you could have international cooperation on such a platform?

Mr. MCELROY. I think the model of the polar-orbiting weather satellites is directly analogous to this. It seems to me that the foreign instruments I described being contributed to those weather satellites could equally well be flown on that polar platform. It seems like a very natural marriage.

Mr. VOLKMER. Very good.

I yield back to the gentleman from Florida, he has some additional questions.

Mr. MACKAY. Dr. McElroy, the thing that is significant about the commercialization of Landsat, it seems to me that it really puts in the issue this question of cooperation with other nations. Now, in that—I might not be totally right about this, but I understand that there has been a substantial investment by other nations in ground stations and in their part of what was to be an international cooperative system.

Mr. MCELROY. Yes.

Mr. MACKAY. And that now that the system has demonstrated that it has huge capabilities, probably greater than anyone imagined—

Mr. MCELROY. Yes.

Mr. MACKAY. They are inclined to feel that they might have been sort of pulled off sides, and now we are suddenly saying well, let's commercialize it. And they may see themselves as having to now start negotiating all over again because we are about to change the fundamental rules of the deal.

Now, it's significant from our standpoint as an oversight committee because if this goes in a way that the other nations don't feel they've been treated fairly, it could prejudice any further efforts to do things internationally.

You are in the middle of that. I'd like to hear your comments on that.

Mr. **McElroy**. I don't sense a major problem there. I deal with those people on a—basically a week-by-week basis. There is certainly apprehension. There are always those who are concerned that the prices may go up to a point where they can't afford it. I think that's a normal concern up until the point that they have to actually sign a contract with the private sector.

I think the work of this committee in drafting the language in the law, which was passed, has protected their interests rather well.

We are distributing copies of that law vigorously to all of them to reassure them about how their interests are protected. I think that if you look at what they would like to do in their own countries and you say, well, what is the real impact of commercialization? Providing the data that's available to them, that facilitiates first order of what they want to do. If it's available to them at a price they can afford, that covers their second problem.

If we believe in a vigorous commercial development in this field, then that should bring the prices within their reach, I would hope. Certainly, we provide a transition period tc—to assist in that process.

So with a little bit of good fortune in this, which I don't think is unrealistic, I do not see a major foreign policy impact. I don't see any problem with our future negotiations with them on other cooperative ventures; I am quite hopeful.

Mr. **MacKay**. Do you see any lessons in this since it has maybe turned out to be kind of a first of a—or state-of-the-art effort to convert what has been an international effort into a—at least our part of it into a private part of it? Are there ventures in which there might be a real conflict between the effort to develop international cooperation and the subsequent effort to put it into the—commercialize it?

Mr. **McElroy**. I honestly don't know of any, sir. If I look at the type of arrangements which the private sector negotiates overseas, frequently of a straight contractual nature, they seem to be able to handle that quite well.

The areas where you obviously get into controversy, as this committee and others have commented on, as we looked at the weather satellite data; clearly, that became a major issue. And we had to make some allowances that if it did go to the private sector, certain data dissemination practices would have to continue.

But I don't see any major inhibition that prevents a private sector firm from going out and doing things. We are certainly trying to facilitate that.

Mr. **MacKay**. Thank you, Mr. Chairman.

Mr. **Volkmer**. The gentleman from New Mexico.

Mr. **Lujan**. Thank you, Mr. Chairman.

I do have one request and a couple of questions.

Dr. McElroy, could you give us a list of the international space activities of NESDIS?

Mr. **McElroy**. Yes, sir, we will be glad to provide that for the record.

Mr. **Lujan**. For the record, if you will.

Mr. **McElroy**. Yes, sir.

[The information is included in Appendix II.]

Mr. **Lujan**. One of the things that—this concerns all of us in the international participation of foreign nations and our Space Station Program. If the French are, and some others might be wanting to look at building their own space station. For the $3 million that we're—billion dollars—that we're talking about, to give them all that know-how. Is that being seriously considered? I'm sure it is. But I'm just wondering if that's—if we're going to spend from $8 billion to $20 billion, whatever the figure may be—from $8 billion to $20 billion—for $3 billion to let all of that information out—how about that, Mr. Pedersen?

Mr. **Pedersen**. Well, I think the important point is—you used the phrase "all of that information"—the way we are structuring our discussions with respect to international participation on space station is that Europe would be responsible totally for developing its own facility that would become a part of the station. It would be done with their own technology, with their own money. There would be a minimal amount, certainly, if we're smart negotiators and good managers, as we think we are—a minimum amount of the kind of "know-how" you're talking about——

Mr. **Lujan**. You used the analogy of a car. You are saying that we would build a car, and they would build an air conditioner if you wanted; a radio if, you know, another nation, or——

Mr. **Pedersen**. Well, I'm always worried about analogies like that because the difficulty with analogies like that is then some people say, "Gee, air conditioners are just things hung on cars and they aren't very important." The space station that we are talking about—the initial space station—is a first step. It's going to—everyone has talked about certainly—it's in NASA's plans to be an evolving, living facility, to which ultimately we would hope private firms and consortiums would add their own facilities, and so on.

So, what we're talking about here is an—is through international participation expanding and developing the overall capabilities of the station, so that they might well, for example, develop, build, and add to the space station a major laboratory facility of some sort, that would be equally important in that sense to laboratories we might add. That would enhance the overall capabilities of the station but would not involve the United States teaching them how to build that.

Now, it's important to also note, however, that the Europeans are not without experience in this area. They, after all, did build and develop with their own technology and their own money the Spacelab, which has been a highly successful—based on its initial flight, anyway—pressurized laboratory module.

So when we talk about teaching them all of this, or allowing them to learn so much, we have to remember that they are not without a lot of experience in some of these areas.

So, I would trust that their investment, which, after all, we are talking in terms of $2 billion or more, which as a percent of their total space expenditures is equal to the $8 billion that we're talking about on this side, would be one of adding to the overall capabilities of the station, and not one of letting them in some way into the back door.

Mr. LUJAN. Maybe it's—the analogy might be: I built a building one time; we got 12 guys together, and each one designed his own suite; some were dentists, some were doctors, one was a laboratory technician, architects—and each one designed their own, and we put the outer design to fit the requirements for each one. Maybe that would be closer to the analogy.

Mr. PEDERSEN. That might be closer. We have used at one time with them the idea of the concept of sort of what we call the condominium principle. It tended to confuse them more than help them because condominiums apparently are not a well-known phrase abroad.

But the point we were trying to emphasize was, unlike the Spacelab, which they developed and built, and then just gave to us, handed to us, and we took over full responsibility for it, we're talking about them developing, designing and developing and adding something to the space station for which they would have a continuing operational and utilization responsibility. And then we're in a position to use your dentist and doctor analogy to barter for access to their facilities in return for access to our facilities, so that all benefit. That's the concept we're pursuing, and I think that's the more fair way to depict it.

Mr. LUJAN. Let me just very quickly, because we have to run on and vote. One of the concerns that I had is, you know, the problems that may develop between NASA and the State Department. Is there a system and place, if somehow that, you know, there would be a NASA desk over at the State Department, and a State Department desk over at NASA, so that, you know, those things could work a little smoother.

Mr. PEDERSEN. Well, I'll start and I'm sure Otho will—I was waiting for the chairman to suggest that I didn't have enough people, but he wasn't apparently in that generous a mood today. [Laughter.]

State Department and NASA work closely together. Otho and I talk frequently. His people—for example, let's take space station as an example. All of the meetings we have had with the foreign participants to workshops and so on--we're having another one in mid-August in Houston. Otho's people have been invited to, they have been participants, active particiants, in it.

My sense is that the communication is rather good. Obviously, from time to time, we come to different projects with slightly different perspectives, slightly different objectives.

And I'm relatively pleased. Of course, I'd be happy to see Otho get more.

Mr. LUJAN. How about Commerce?

Mr. PEDERSEN. Resources.

Mr. LUJAN. You know, your missions clearly are different. Theirs is—I must tell you, I'm more attuned with Commerce—let's get it out into the——

Mr. Pedersen. Well,——

Mr. Lujan [continuing]. Private sector, let's do the research and get it out.

Mr. Pedersen. Commerce is a many splendored thing. It depends upon what parts of the Department of Commerce you may be referring to. We have excellent—obviously, excellent—relationships, I believe, with NOAA, and with Dr. McElroy's——

Mr. Lujan. Well, those that——

Mr. Pedersen [continuing]. Areas.

Mr. Lujan. Want to put it out into the commercial section——

Mr. Pedersen. Yeah.

Mr. Lujan [continuing]. Sector.

Mr. Pedersen. Those relationships—I think the fairest way to describe those, from my point of view right now, is those are in the process of being defined. This is a fairly new initiative that the President has taken. I think it's going to take a little bit of time to define those relationships. There's always a little pushing and hauling.

But my sense is that no more than normal. At least, no more than normal in my 13 or 14 years of experience in Government. Whenever newer missions are defined, or jurisdictions are allocated, I have not sensed a major problem.

Mr. Lujan. Is there a feeling in NASA whatever is ready for this private sector, let's kick it out and let's——

Mr. Pedersen. NASA's philosophy has always been, as best demonstrated by two projects we've mentioned already today: Landsat and Search and Rescue, that our job is the research and development, to take it through that phase of experimentation which demonstrates it has promise, and then spin it off. And I think our record's pretty good there.

Mr. Lujan. At that point?

Mr. Pedersen. Well, certainly that's been discussed widely, as you know, by many people. I can only say that Mr. Beggs, who is as authoriative as I would care to get on this, has said, and on numerous occasions, that it is a subject about which he has an open mind, and in which he sees that as being certainly an option that ought to be seriously considered.

Mr. Lujan. Thank you, Mr. Chairman.

Mr. Volkmer. How many people do you have, Ken?

Mr. Pedersen. Not enough, Mr. Chairman. Secretarial and professional, I believe I have 18.

Mr. Volkmer. Eighteen?

Mr. Pedersen. Yes.

Mr. Volkmer. Mr. Eskin has six.

Mr. Pedersen. Yes, but you have to remember, he named all those other bureaus and parts of State that help him out. He has smaller shock troops but larger supporting legions.

Mr. Volkmer. All right. Thank you very much.

I thank all three of you very much. We're going to have to adjourn the meeting at this time and go vote. Thank you very much.

[Whereupon, at 12:25 p.m., the subcommittee was adjourned.]

APPENDIX I

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

"INTERNATIONAL COOPERATION AND COMPETITION IN CIVILIAN SPACE ACTIVITIES—SUMMARY," A REPORT TO THE COMMITTEE ON SCIENCE AND TECHNOLOGY AND TO THE JOINT ECONOMIC COMMITTEE; OFFICE OF TECHNOLOGY ASSESSMENT, JULY 1984; SUBMITTED TO RECORD AS TESTIMONY BY RAY WILLIAMSON, OTA

Foreword

The nature of global space activities has changed radically over the last decade. No longer are the United States and the Soviet Union the only countries capable of placing satellites into Earth orbit or sending interplanetary probes into deep space. Europe and Japan now have substantial space programs and have developed commercially competitive space systems. Several newly industrialized countries are well along in building their own space programs. In addition, the U.S. private sector has recently expanded its interest and investment in space technology. As this report makes clear, these changes have strong implications for the U.S. Government space program and for the U.S. private sector.

This summary presents the major findings of an assessment requested by the House Committee on Science and Technology and the Joint Economic Committee on international cooperation and competition in civilian space activities. The United States still enjoys a strong competitive position in most space technologies and in space science. There continues to be broad support for a long-term public commitment to civilian space activities. But precisely because of our achievements—and those of other space faring nations—the number of opportunities (and associated costs) that lie before us require a thoughtful articulation of space goals and objectives.* Such goals should reflect a broad public consensus, including, but not limited to, those with obvious stake holdings in the space program. Defining these goals may be essential if the United States hopes to maintain its position of leadership at a reasonable cost. The newly authorized National Commission on Space, which OTA proposed as one option in an earlier report *(Civilian Space Policy and Applications)*, could help to focus the national debate.

Maintaining a space program well-integrated with other national objectives will also require attention to the quantity and quality of cooperative international space projects. This report makes clear that the United States must cooperate in space in order to stay competitive.

In the course of this assessment OTA completed two technical memoranda, prepared at the request of congressional committees. *UNISPACE '82: A Context for Cooperation and Competition*, was requested by the House Committee on Science and Technology and the Joint Economic Committee. *Remote Sensing and the Private Sector: Issues for Discussion* was requested by the House Committee on Science and Technology and the House Committee on Government Operations. Some material in this report is discussed in more detail in the technical memoranda.

In undertaking this assessment, OTA sought the contributions of a wide spectrum of knowledgeable and interested individuals. Some provided information, others reviewed drafts of the report. OTA gratefully acknowledges their contributions of time and intellectual effort.

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*For an initial suggested list of such goals and objectives, see *Civilian Space Stations* (Washington, DC: U.S. Congress, Office of Technology Assessment, OTA-STI-241, in press.)

John H. Gibbons

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NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by these advisory panel members. The views expressed in this OTA report, however, are the sole responsibility of the Office of Technology Assessment.

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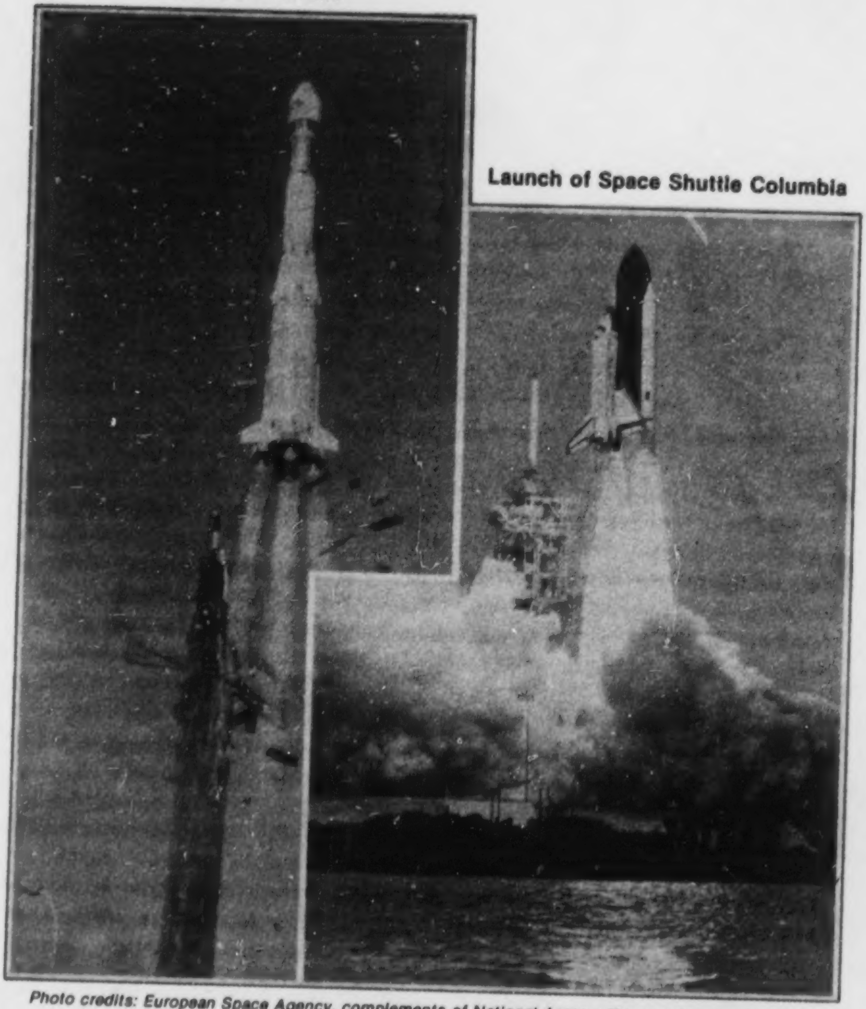

Launch of Ariane

Launch of Space Shuttle Columbia

Photo credits: European Space Agency, complements of National Aeronautics and Space Administration

Launch of Ariane (left), developed by the European Space Agency and marketed by the French corporation Arianespace, S. A. Launch of Space Shuttle Columbia (right), Nov. 28, 1983, carrying the European-developed Spacelab

International Cooperation and Competition in Civilian Space Activities

OVERVIEW

The United States has lost its monopoly in Western space technology and operations; over the past decade, Europe and Japan have developed the means to compete as providers of space-related goods and services. At the same time, major U.S. firms have expanded their interest and investment in the commercial applications of the technologies of outer space. Both developments affect the ways that nations now cooperate in space. **Unfortunately, U.S. policies have not adapted fully to the effects of increased foreign competition, nor, outside of satellite telecommunications, has the United States developed ways to involve its private sector effectively in applications of space technology.** Moreover, it is less and less appropriate to make "space policy" in isolation from the broader agenda of domestic and international commerce and foreign affairs.

Alterations in the political, economic, and technical context of space activities raise **four major international concerns for Congress: the state of U.S. competitiveness in space technologies, the role of the U.S. private sector in space, the access of U.S. firms to international markets, and the efficacy of U.S. participation in international cooperative space projects and organizations.** Because of these concerns, and because of their interest in developing policies to enhance the overall scientific, technological, and economic strength of the United States, the House Committee on Science and Technology and the Joint Economic Committee requested this assessment.

The report assesses the state of international competition in civilian space activities, explores U.S. civilian objectives in space, and suggests alternative options for enhancing the overall U.S. position in space technologies and space science. It also investigates past, present, and projected international cooperative arrangements for space activities and examines their relationship to competition in space. In keeping with the international focus of this assessment, the report discusses the relationship between space policy and foreign policy. It analyzes domestic policy issues only insofar as they affect our ability to sell goods and services abroad or to cooperate effectively with other nations. It does not assess policies related to the military and intelligence space programs except to the extent that they affect international civilian activities in space.

CONTEXT

Emergence of International Competition

Although the U.S. civilian space program remains the benchmark by which other non-Communist nations judge the progress of their own space programs, **Japan and the Western European space powers (especially France) are now able to compete with the United States in supplying some space-related goods and services.** Other countries, notably the Soviet Union, Canada, India, Peoples Republic of China, and Brazil, produce space items but do not participate in the international export market. Most space-capable nations have sought to use their space assets as political instruments for cementing ties with friends and allies and for winning new friends and influence in the developing world.

Space-related international commerce is likely to increase in the next decade, but, except for satellite communications, will continue to be shaped more by the political, military, and economic interests of national governments than by market developments. In the satellite communications sector, which has become part of the larger telecommunications industry, technology-driven market developments are forcing governments to change their regulatory structures.

The emergence of foreign competition presents both a challenge and an opportunity to the United States. The European Space Agency (ESA), which pools the space interests and the financial and industrial resources of several European countries, is an important vehicle for developing European competitive ability in space-related commerce. Its largest single project, the Ariane expendable launch vehicle, built under French leadership, now competes directly with U.S. launch services. ESA's second largest project, the Spacelab, built under West German leadership, has increased European cooperation with the United States in activities involving humans in space. It has also assisted West Germany to gain important expertise in building space habitats, thereby helping to set the stage for possible later competition with the United States.

Outside of the ESA framework, **the French Government has established and promoted particular space businesses (launch services and remote sensing) that compete in the world market. West Germany, as well as France, and to a lesser extent, the United Kingdom and Italy, invest in space activities for more general purposes:** to conduct basic scientific research; to enhance the technological capabilities of national industries; to realize some of the technological and economic benefits of space applications; and to develop space-related equipment industries. European governments are developing their space-related industry behind protectionist barriers where buy-national government procurement is the rule. A number of European firms are now able to participate in international space markets.

Like the other space powers, Japan has assumed that a government space program will ultimately contribute to national economic well-being. It has not specifically identified space industries as "targeted" for special em-

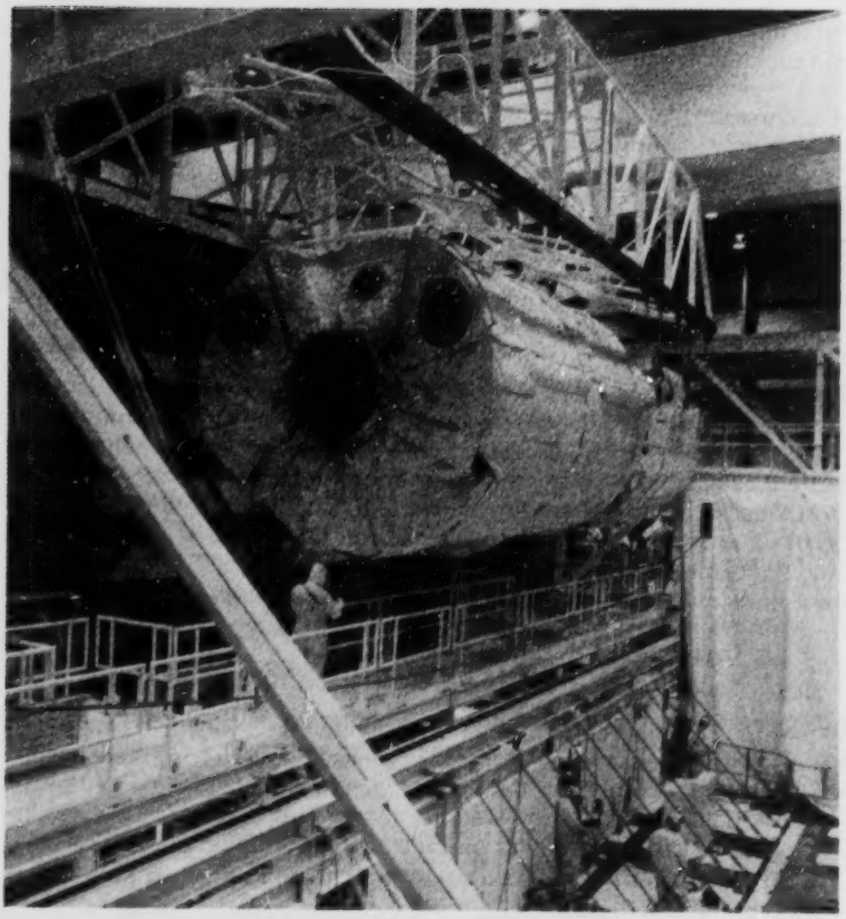

Photo credit: National Aeronautics and Space Administration

The European-built Spacelab-I module and attached pallet being prepared for installation in the cargo bay of the space shuttle orbiter Columbia, Aug. 16, 1983

phasis in export competition; instead it seems to be aiming to create a sizable space-related industry increasingly independent of U.S. technology and equipment. Although they now compete internationally only in electronics components and ground stations, **Japanese firms will be well positioned to become major competitors in international markets for space-related equipment and services by the early 1990s.** Under internal and U.S. pressures, Japan has recently opened its market to a limited degree to U.S. suppliers of satellites and telecommunications equipment.

Although the Soviet Union has the technological potential to compete with other countries for commercial services, space competition between the United States and the Soviet Union will continue to be more political and military than economic. Both nations today spend more on military than on civilian activities in space and make heavy use of space for purposes of geodesy, navigation, weather forecasting, reconnaissance, missile-launch warning, and communications. They are beginning to compete in developing weapons for use in space.

In space-related equipment and some service markets, international commercial competition outside of the European and Japanese markets occurs in countries like Brazil, India, and Australia, which desire to develop domestic satellite communications, and in INTELSAT and INMARSAT,* but the largest market where substantial open competition in sales of equipment takes place is the U.S. domestic market. U.S. firms continue to dominate both markets, although Japanese ground-equipment sales have been substantial in developing countries.

In satellite communications services, international competition is currently almost nonexistent, except to a limited extent in North America. Carriers typically must hand off communications at foreign borders or at the geostationary orbit, and are not allowed to sell full international services to consumers. In addition, INTELSAT has monopoly ownership of intercontinental satellite communications facilities, but major U.S. carriers and other firms are challenging this international regulatory management.

U.S. Private Sector Activities in Space

Some of the largest U.S. corporations are now heavily involved in space-related activities, especially satellite communications. Other firms are beginning to invest in developing their own space transportation, remote sensing, and materials processing systems. Many corporations derive significant revenues from producing specialized space-related equipment.

However, except for satellite communications, significant barriers of high cost and high technological and economic risk continue to deter investment. In space transportation and remote sensing, competition from U.S. Government-operated systems is a significant impediment. Nevertheless, fueled by technological advances and Government policy, the trend is toward more U.S. private investment in space systems. If current trends continue, there will be a wide array of privately financed space activities by the mid-1990s.

One continuing difficult task facing the U.S. Government will be to foster, in concert with the private sector, an efficient transition from the current preponderance of Government investment in civilian space activities to greater private sector investment in the 1990s. Such a transition occurred easily in satellite communications, because the demand for telecommunication services was already established and satellite circuits were an immediate cost-effective way to accomplish what was already being done on Earth. **In new technology sectors, with small and uncertain demand, and little institutional infrastructure, the process of transition is likely to be difficult and highly specific to the sector.** The process will require periodic attention from Congress. In these sectors, Government may be able to foster effective transitions by orienting its research and development (R&D) activities toward realistically evaluated market demand and by involving industry early in the process. One such strategy is the National Aeronautics and Space Administration's (NASA) Joint Endeavor Agreement (JEA), through which the private sector is encouraged to share costs with NASA on projects having significant research objectives and potential commercial application.

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*INTELSAT is a 108-country organization carrying two-thirds of the world's international communications. INMARSAT is a 37-country organization which was established in 1979 to facilitate maritime communications across the world's shipping lanes. COMSAT Corp. has been designated by the U.S. Government to serve as the U.S. representative to both organizations.

International Cooperative Activity

Space is by nature and treaty an international realm. The United States has played the leading role in international cooperative activities by sharing the fruits of its research with developing countries, assisting other industrialized nations develop their own space capabilities, and by helping to establish the international legal regime in space.

U.S. cooperative space projects continue to serve important political goals of supporting global economic growth and open access to information, and increasing U.S. prestige by expanding the visibility of U.S. technological accomplishments. U.S. noncommercial international space projects have been managed principally by NASA, and aided by the National Oceanic and Atmospheric Administration (NOAA) and the Agency for International Development (AID). These projects also support U.S. economic, scientific, and technological goals of obtaining access to countries for tracking stations and ground-receiving stations, influencing the space programs of other countries, and expanding research opportunities for U.S. scientists by sharing costs with other countries.

The examples of INTELSAT and INMARSAT, two commercially successful international cooperative organizations, illustrate that countries with political differences can cooperate to pursue common social, political, and economic goals in space. INTELSAT, in particular, by establishing new communications links and using advanced technology has served an expanding international market for telecommunications and services. It has been a large buyer of U.S. satellites.

Until recently, the United States had a virtual monopoly on the conduct of cooperative international programs in space (at least in the West). Now, in part because of the very success of U.S. efforts to involve the international community, other nations—especially Japan and some European nations—have developed their own bilateral cooperative programs. The Soviet Union continues to expand its international cooperative relationships in science and space applications. As a result of these circumstances, the United States is now one of several potential partners in cooperative space projects.

Developing countries will continue to depend on the United States and other industrialized nations for help in expanding their own capacity to use and develop space technology. **If the United States wishes to reap the full economic and political benefits of its space program, its cooperative applications programs must continue to involve the developing countries, especially because they are beginning to represent a significant market for space-related goods and services.**

The United States participates in various international organizations and meetings on space. Improved U.S. preparation for these international forums could result in more favorable treatment of U.S. interests and concerns. U.S. experience at UNISPACE '82[1] and the International Telecommunication Union (ITU) Plenipotentiary* demonstrated that such improvements will require long-term domestic policy goals for outer space; more effective coordination among U.S. agencies and the private sector; greater continuity of personnel; and recognition that our critics may also represent important future markets. The series of ITU meetings in the 1980s and 1990s, including ORB'85 on the geostationary orbit, will present occasions where U.S. policy will be tested.

SPACE APPLICATIONS

OTA examined a range of space technologies. Each is at a different stage of commercial development or Government operational status. Each therefore presents a different set of potential opportunities.

Space Transportation

The emergence of competition from foreign and U.S. private sellers of launch services requires a reassessment of the U.S. Government's traditional role as provider of launch services to commercial interests. The Government must examine whether and how it should continue to use the Shuttle in competing for foreign and domestic commercial launches.

The entry of ESA's Ariane booster into the international launch vehicle market brought an end to NASA's monopoly in providing space transportation services to commercial entities and foreign governments. Eventually Japan will also be able to offer competitive commercial launch services; still other nations are developing their own means to launch payloads. In some respects, national launch vehicle programs can be compared to national airlines: some are conducted primarily for profit, while others play a role which is clearly linked to perceptions of "prestige" and "national self-image." For these reasons, **U.S. competitive strategies based on price or superior technology alone will not prevent foreign entry into the launch services business.** Nations that possess the commitment and the minimum

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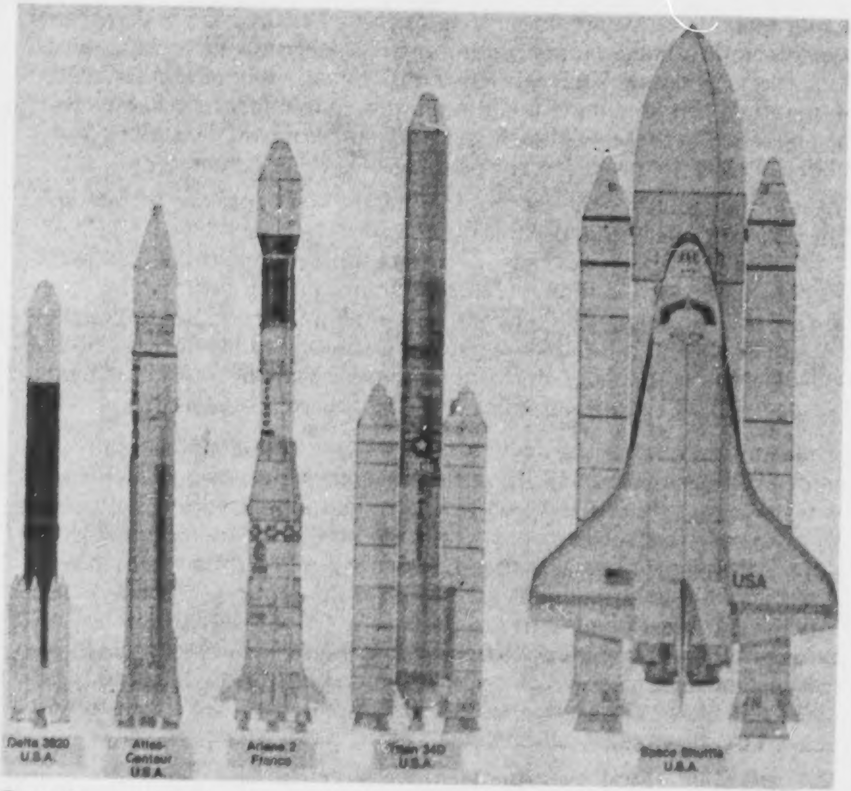
[1] See *UNISPACE '82: A Context for Cooperation and Competition* (Washington, DC: U.S. Congress, Office of Technology Assessment, OTA-TM-ISC-26, March 1983).

*The ITU Plenipotentiary Conference was held in Nairobi in September 1982. See hearings before the Subcommittee on International Operations of U.S. House Committee on Foreign Affairs, Feb. 22, 1983.



Current competition in space launching services from Earth to orbit is between these five launchers

SOURCE: National Aeronautics and Space Administration.

economic and technical resources necessary to develop launch systems will take some share of the total world market.

Although there are a number of potential entrants, launch service competition for the next decade is likely to be primarily between NASA, operating the Shuttle, and Arianespace, S.A., the French corporation* which markets the Ariane. **Both systems use technology developed by governments and compete primarily for the launch of large geosynchronous communication satellites. The Shuttle, although technically more sophisticated than the Ariane, has no special advantage in this market.** In addition, several U.S. private firms are competing in offering launch services.

A large percentage of potential launch business will undoubtedly be removed from international competition. For instance, with few exceptions, neither the U.S. Government nor the Japanese or European governments are expected to make launch procurement decisions under competitive international bidding. Such restrictive trade practices could be altered by international agreement in the distant future; in the near future, however, it is unlikely that there will be effective coverage of launch services under either government-procurement or trade-in service agreements.

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*The French Government owns the majority share of Arianespace. The balance is owned by other European governments and some European aerospace firms.

Much of the competitive part of the market will consist of private U.S. communications carriers putting up U.S. domestic satellites. INTELSAT, INMARSAT, and a few countries will also purchase satellite launching services competitively. Customers will base their choice on price (including the cost of financing), the reliability of launch and schedule, the relative ease of planning and processing payloads, the cost of insurance, and the availability of coproduction and other offsets. As with all large international contracts, political considerations will undoubtedly play a role.

The Administration policy on launch vehicle commercialization is ambiguous. On May 16, 1983, President Reagan announced that the U.S. Government fully endorsed and would facilitate the commercial operation of expendable launch vehicles (ELVs) by the private sector.* However, the President also stated that the Shuttle is the "primary launch vehicle of the U.S. Government" and that it would continue to be available for domestic and foreign commercial users. **The President's policy encourages "free market competition among the various systems and concepts within the U.S. private sector," yet leaves the Government-subsidized Shuttle as the main competitor to the private sector's efforts to market ELV services.**

Current Shuttle prices were developed to encourage users to transfer their business from the trusted ELVs, then operated by the Government, to the Shuttle. According to NASA, launch prices for the 1986-88 period will be based on the "out-of-pocket" costs, that is, those costs which a commercial payload adds to a mission on the assumption that it would otherwise fly partially empty when carrying a Government payload. **Current and projected pricing policies for commercial payloads allow the Shuttle to compete with Ariane's prices while earning some revenue and supporting other important national space goals; however, these policies decrease the probability that U.S. private firms will be economically successful in providing competitive launch services.**

The United States can meet the challenge of competitive foreign launch services by favoring either the Shuttle or private ELVs for commercial payloads. If the demand for launch services were to increase dramatically, both kinds of vehicles might successfully offer commercial launch services; but since a dramatic increase seems unlikely in the 1980s, the United States must choose which course it intends to follow.

Continuing to favor the Shuttle, by pricing policy or by other means, would reinforce its status as the centerpiece of the U.S. space program and support the pursuit of other long-term space goals such as building space stations, encouraging the development of manufacturing in space, and investigating new military space technologies. Such a decision would likely increase the cost to the taxpayer of the U.S. space program if it leads to additional subsidized Shuttle flights.

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*The Titan, the Atlas-Centaur and the Delta launch vehicles have all been the target of efforts to commercialize existing ELVs. Other smaller, private expendable launch vehicles are in development.

In order to spur the growth of an internationally competitive, private ELV industry, it would probably be necessary to limit the Shuttle primarily to Government launches or to increase the price of commercial Shuttle flights substantially. Additional support might be given to fledgling launch companies in the way of low-price access to Government launch facilities, assured launches (e.g., the Air Force's recent desire to purchase 10 ELVs), and a regulatory environment conducive to private investment.

Allowing commercial ELV firms to compete profitably might result in the emergence of a thriving, mature private space transportation industry in the United States by the 1990s. Because the Ariane and U.S. ELVs have comparable capabilities, such a decision might also allow the Government-subsidized Ariane to capture a larger portion of the international launch market than it would if it were competing against the subsidized Shuttle.*

Satellite Communications

Unlike other technologies discussed in this report, satellite communications technology has passed from Government-dominated investment to commercial status. Civilian satellite communications is now fully established within the overall telecommunications industry.

Competition in International Satellite Communication Services

In the United States, increasing numbers of satellite communications service providers, and types of services, have forced examination of the structure of the international satellite communications industry. In particular, several U.S. communications corporations have recently applied for authority from the Federal Communications Commission (FCC) to launch satellites to provide transatlantic satellite communications services. **The United States must soon decide whether it wishes to continue its past support of INTELSAT as the only provider of intercontinental satellite communications facilities** or whether it will permit U.S. firms to launch independent and/or competitive satellites.** Preventing U.S. firms from owning independent international satellite facilities would close off certain potentially profitable opportunities to them. But INTELSAT's monopoly status is strongly supported by many other governments. The United States

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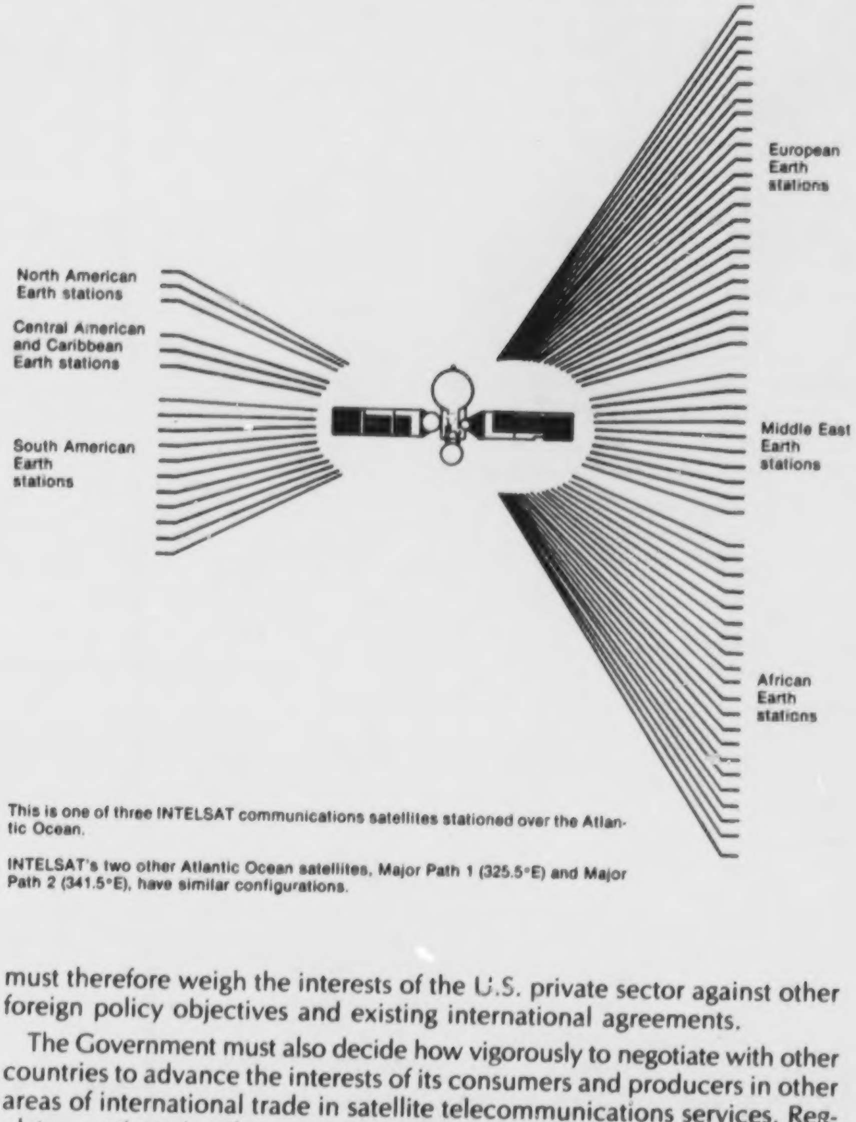
*Relatively powerful trade remedies for unfair foreign competition against U.S. goods and services are available to the Government. Recently, for example, Transpace Carriers, Inc., the company seeking to commercialize the Delta launcher, applied to the President to prohibit Arianespace from marketing its services in the United States and to penalize U.S. imports from the countries subsidizing Arianespace, S.A., under Section 301 of the Trade Act of 1974.

**Although all commercial intercontinental satellite traffic must pass through INTELSAT, regional systems provide limited international services in the regions they serve.

INTELSAT Atlantic Ocean Primary Satellite 335.5°E


European Earth stations
North American Earth stations
Central American and Caribbean Earth stations
South American Earth stations
Middle East Earth stations
African Earth stations

This is one of three INTELSAT communications satellites stationed over the Atlantic Ocean.

INTELSAT's two other Atlantic Ocean satellites, Major Path 1 (325.5°E) and Major Path 2 (341.5°E), have similar configurations.

must therefore weigh the interests of the U.S. private sector against other foreign policy objectives and existing international agreements.

The Government must also decide how vigorously to negotiate with other countries to advance the interests of its consumers and producers in other areas of international trade in satellite telecommunications services. Regulatory regimes in other countries prevent private carriers from competing freely in international communications service markets. Other nations typically require that communications reaching their territories be handled by their governmental telecommunications monopolies and accept traffic only from designated U.S. carriers in each market segment. Among the alternatives are: 1) bilateral negotiations with individual countries with the short-term objective of access for additional U.S. carriers; and 2) longer term multilateral negotiations on a general GATT* code on trade-in services.

All of the foregoing has resulted in a situation where U.S. consumers have fewer price-service options in international than in domestic telecommunications markets. Moves toward freer international competition would be consistent with domestic steps toward deregulation and with recent U.S. efforts to secure fairer international trade.

Demand for Satellite Communications Services

Demand for all international telecommunications services is now probably increasing at 10 percent or more per year. **Within this, demand for satellite communications services is also increasing rapidly, but whether its growth will continue through the 1990s is highly uncertain. Satellite services will continue to dominate long-distance international communications at least until 1988, when the first transatlantic fiber-optic cable is scheduled for operation.** In the 1990s, annual growth in the demand for international satellite communications services could range from zero to a rate equal to the growth of international communications as a whole, depending on the relative shares of satellites and fiber-optic cables. The shares of satellites and cables will depend in turn on consumer preferences, business incentives, industry structure, and above all, on regulatory decisions. It is unlikely that the total demand for international satellite communications will decline during the 1990s.

Competition in Satellite Communications Equipment Market

U.S. satellite communications equipment firms continue to dominate the relatively open international markets, including the U.S. domestic market. However, access by U.S. producers of satellites and other satellite communications equipment to most industrial country markets is restricted by "buy national" policies on the part of post, telephone, and telegraph agencies (PTTs) or consortiums of PTTs, who are the primary purchasers of such equipment. Most governments purposely excluded their PTTs from coverage under the GATT code on government procurement, and thus multilateral trade remedies are not available.

Some bilateral progress has recently been made on opening up the Japanese communications satellite equipment market to U.S. suppliers, but European markets remain tightly protected. Meanwhile, deregulatory and antitrust actions in the U.S. domestic long-distance telecommunications market have opened up the U.S. equipment market to international competitors. Consequently, foreign communications equipment manufacturers have greater access to the U.S. market than U.S. sellers have to theirs.

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*General Agreement on Tariffs and Trade.

Advanced R&D

Although some level of Government R&D funding may be necessary to maintain the competitiveness of the U.S. satellite communications equipment industry, Congress must determine how much is appropriate. Increasing congestion in the geostationary orbit over the Western Hemisphere for satellites using frequencies in the C-band (6/4 GHz) and Ku-band (14/12 GHz) may create a market opportunity for Ka-band (30/20 GHz) satellites in the 1990s. This opportunity, along with potential competition from foreign satellite system manufacturers, has led to the NASA Advanced Communications Technology Satellite (ACTS) program, which would develop a Ka-band system. ACTS components would be more advanced than Ka-band technology under development in Europe or Japan; some aspects of ACTS technology would also be applicable in satellites operating in the C- and Ku-bands.

Some satellites operating in the Ka-band may well be launched in the late 1980s. Hughes Aircraft Co. has already applied for permission to launch two. As planned, they would also be less advanced than the proposed ACTS system, but Hughes questions whether an ACTS-type system would be commercially viable. Depending on its perception of the threat of subsidized foreign competition and the capabilities of the U.S. private sector to meet it, Congress could: 1) continue to fund the full ACTS program through the flight testing stage, 2) fund only minimal communications satellite research, or 3) fund only that part of the ACTS research that can be carried out on the ground or in small-scale Shuttle experiments (on the assumption that the private sector will finance spacecraft tests of commercially viable innovations or that spacecraft tests could be postponed until foreign plans were clearer).

Participation in the International Telecommunication Union

Because most of the communications satellites over the Western Hemisphere belong to U.S. private firms or the Government, the United States has an interest in protecting the current method of allocating slots in this hemisphere's portion of the geosynchronous orbit. Slots are now registered by the International Telecommunication Union (ITU) according to a policy of "first-come, first served." However, many countries of Central and South America, along with other developing countries, espouse the principle of a priori allotments, whereby countries would be assigned slots in advance of actual need.

The ITU has called the 1985-88 World Administrative Radio Conference ("Space WARC") to consider international arrangements for planning and implementing the use of communications satellites in the geosynchronous orbit. (The particular meeting which will do so in 1985 is known as ORB'85.) **If the United States faced a limited allotment of geosynchronous slots, it would be obliged to deploy substitute capacity in the Ka-band or in fiber-optic cables, presumably incurring additional costs.** One such cost might be the premature obsolescence of certain C- and Ku-band ground equipment. If C- and Ku-band slots had to be rented from countries to which they had been assigned a priori, such rents would also be an extra cost to U.S. consumers of satellite communications. Participation in ORB'85 will require careful planning and coordination among several U.S. Government agencies and the private sector. An isolated, combative stance in ORB'85 on the part of the United States against a priori planning could lead to difficulties in solving other international telecommunications issues. In particular, ill-considered U.S. actions that disrupted the ITU's decisionmaking processes could lead to changes in international arrangements for allocating and assigning frequencies to civilian and military communications in general.

Remote Sensing From Space

Land Remote Sensing[2]

The U.S. Landsat system is currently the only civilian land remote sensing system from which worldwide data are available. **By 1990, several other countries, including Canada, France, Japan, and perhaps the Soviet Union, expect to deploy competing systems to sense the oceans and the land.** France is treating its Systeme Probetoire d'Observation de la Terre (SPOT) as a commercial enterprise and has organized to market Earth resources data when the system becomes operational in 1985.

NASA developed the Landsat system and managed it as an R&D project until January 1983; Landsat is now managed by NOAA as a Government operational system. Landsat 5, launched in March 1984, is expected to be the last in the Government's Landsat series. Although NASA and NOAA will continue advanced research on new sensors and data processing techniques, using the Shuttle to test new methods, the Administration and Congress are now moving to transfer the operation of land remote sensing to the private sector.

Although the small size of the present market for Landsat data and consequent high economic risk* stand as major impediments to full commercialization, several private firms have expressed interest in providing land remote sensing data commercially. **Phased transfer to private hands, in which a designated private firm uses its commercial skills to develop a market for Landsat data, may result in an overall market for data and services adequate to support both a self-sufficient land remote sensing business and the entrance of more than one data seller.****

Without sufficient oversight, transfer of land remote sensing to the private sector would negatively affect our relationships with other nations. In view of the continued importance of the "open skies" principle to the United States, recent legislation*** continues the policy of nondiscrimi-

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[2] See also *Remote Sensing and the Private Sector: Issues for Discussion*, (Washington, DC: U.S. Congress, Office of Technology Assessment, OTA-TM-ISC-20, March 1984).

*The current annual market for Landsat data is about $10 million. Satellite capital costs (for a 5-year lifetime) are likely to be greater than $100 million.

**H.R. 5155, passed by Congress June 28, 1984, provides for a phased transfer.

***H.R. 5155

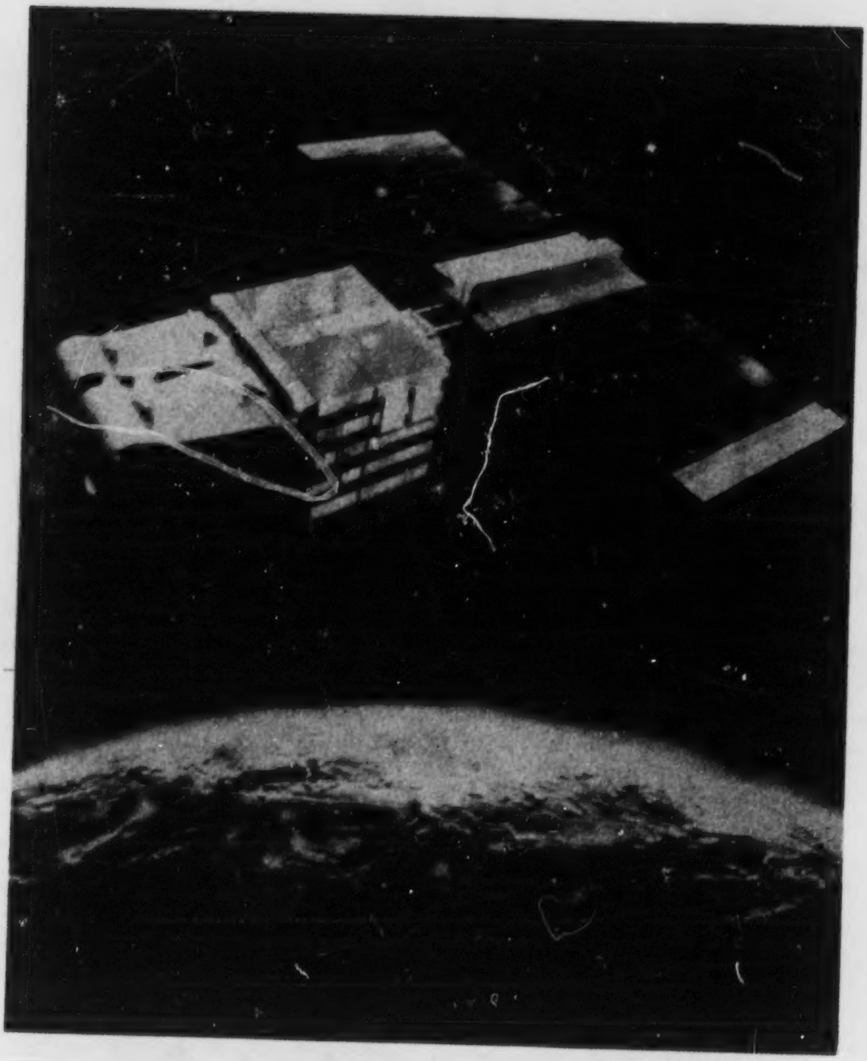

Photo credit: SPOT Image Corp.

Artist's conception of the French SPOT remote sensing satellite. Property of CNES, France

natory sales of land remote sensing data. Not to do so would be harmful to many U.S. foreign policy interests, not just those involving outer space. Because the first commercial U.S. land remote sensing data supplier will have a near monopoly position, it may also be appropriate to restrict it from entering into the value-added business* until a competitive international remote sensing industry develops. Developing country buyers may otherwise realistically fear that there may be discriminatory access to data.

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*Value-added remote sensing corporations process and manipulate remote sensing data to increase their value to the end user.

Lack of dependability of data delivery continues to be the single most important concern of current and potential domestic and international customers of remotely sensed data from space. The lengthy debate over the Landsat program has caused both domestic and foreign customers to limit their investment in land remote sensing hardware and services. Such limitation of investment, in turn, has impeded the development of international markets for Landsat-derived products. **Building a substantial market for remote-sensing data will likely require sizable subsidy for a period of years. It will also require system improvements that lead to low-cost data products, and a strong value-added industry.** It will be especially important for the Government to avoid competing with value-added firms.

Remote sensing data services are part of the information industry; interpretation and integration of these data with other data require extensive use of information technology. **Successful commercialization of Earth resources space-related systems is therefore directly dependent on advances in information technology that will make data manipulation, storage, and retrieval simpler and less expensive.** In particular, as microcomputers become more powerful, and as appropriate computer software is developed, even relatively unsophisticated users may eventually become purchasers of Earth resources data products—if their prices become sufficiently low.

The pressure for international agreements requiring "prior consent" to acquire remotely sensed data from another country will continue to mount as spatial and spectral resolution improve. However, if a strong, open, competitive market for data products and data services develops, such pressure is likely to diminish.

Meteorological Satellites (Metsats)

Public Law 98-166 prevents the sale or transfer of U.S. metsat systems to private industry and requires that they be operated in the public interest. At present, the commercial value-added market for weather data from satellites is extremely small. However, **innovative applications of metsat data to agriculture and hydrology demonstrate that, when properly processed and integrated with other data, they can sometimes substitute effectively for moderate resolution land remote sensing data.** Because metsat data have the advantage that they are sensed and delivered twice daily, their use for these purposes may reduce the market for higher resolution, Earth resources data.

As meteorological satellite systems have grown sophisticated and consequently more complicated, costs of building and operating the systems have also grown. In contributing to the continuity of international collection and analysis of environmental data, the United States could follow one of the following policy options: 1) It could continue to operate two civilian polar orbiters and two geostationary satellites and share data in-

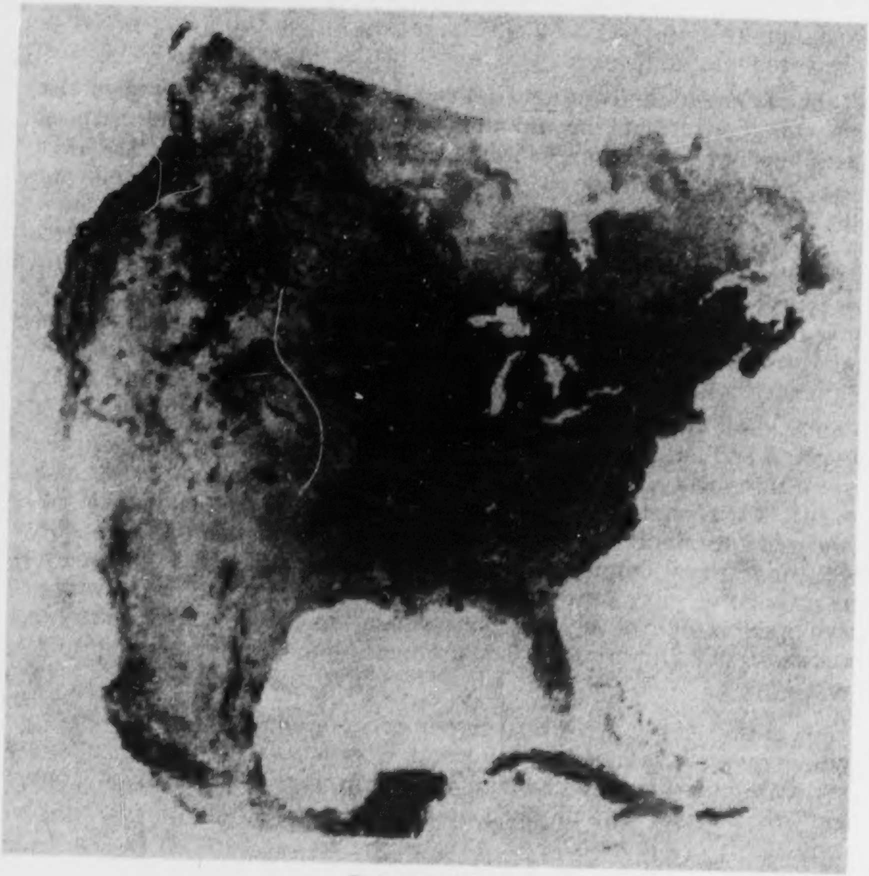

Photo credit: National Oceanic and Atmospheric Administration

Six-day normalized vegetative index composite made with data from instruments aboard the NOAA-N series polar orbiter

ternationally. 2) It could operate only one polar orbiter. Reducing polar-orbiter service would likely save roughly $25 million per year, but would lead to reduced service to Hawaii and Alaska as well as to the U.S. military. It would also reduce our ability to share metsat data with other nations. 3) Alternatively, the United States could join with other industrialized nations in a joint international system, as the Administration has proposed. The United States could save money on building and operating meteorological satellites *and* demonstrate its leadership in developing space for peaceful purposes by joining with other nations to build and operate such a system.

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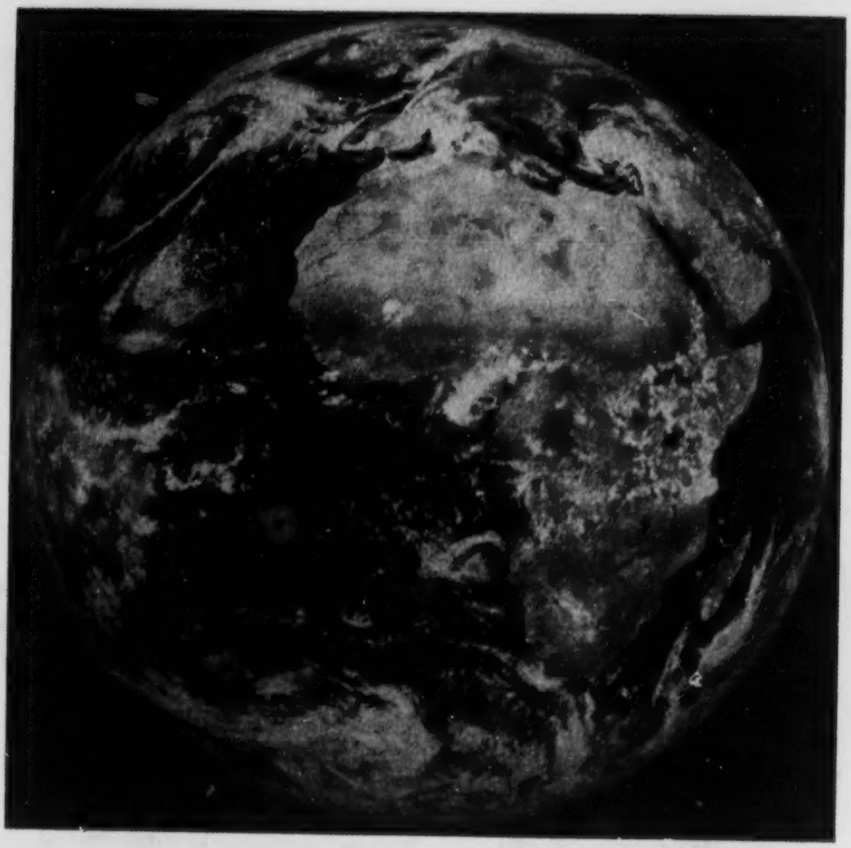

Photo credit: European Space Agency

Visible wavelength image of weather patterns on Earth, as taken by Meteosat, the European geostationary meteorological satellite. Meteosat was developed and built by the European Space Agency

Ocean Remote Sensing

NASA's experimental Seasat ocean remote sensing satellite demonstrated in 1978 the utility of collecting data on properites of the ocean from space. Although no U.S. civilian system is now foreseen, the U.S. Navy is planning an operational ocean remote sensing satellite (Navy Remote Ocean Sensing Satellite—NROSS) for launch in 1988 or 1989. NOAA will collect and distribute data from NROSS. Canada, ESA, and Japan all expect to have operational civilian ocean remote sensing systems in the late 1980s or early 1990s. None of the systems by themselves will produce the full range of useful ocean data. **If all parties were willing to coordinate satellite orbits and to supply their data in usable form, NOAA could play a crucial role in collecting, organizing, and distributing data from the U.S. Navy and the foreign ocean remote sensing systems.** Alternatively, at some time in the future, it may be desirable to develop an international ocean remote sensing system.

Remote Sensing in Developing Countries

Most developing countries lack the basic infrastructure to use Earth remote sensing data efficiently. Because the meteorological terminals are relatively inexpensive to install and operate, **gaining experience with receiving and processing weather data may be the best way for developing countries to build the infrastructure necessary to utilize remotely sensed land or ocean data.** At the same time, advances in information technology that will make it easier and cheaper to process remotely sensed data will vastly improve the ability of the developing countries to use them. By continuing to support remote sensing programs in developing countries, the United States could help these countries develop their own resources and stimulate the international market for land remote sensing data products.

Materials Processing in Space (MPS)

There is no international commercial competition in MPS because commercially significant MPS products have yet to be developed; governments are now responsible for most MPS research activities. Given the cost and complexity of research in space, and the limited understanding of space processing and its supporting technology, international cooperation in MPS research could contribute substantially to long-term U.S. objectives in space. A few firms, working with NASA, are studying specific processes which could result in commercial products.

The primary motivation for studying the properties of materials in space is to use a microgravity environment for extended periods for scientific and, perhaps, commercial applications. Operating in a near zero-gravity environment may lead to improvements in controlling process variables such as temperature, composition, and fluid flow, and afford opportunities for understanding and improving ground-based production methods. Where economical, it might eventually lead to manufacturing selected products in space.

Should MPS products prove to be commercially viable, the United States would eventually face market competition from other nations who are also gathering experience in microgravity research.* Most foreign MPS activities have been conducted by ESA under the primary sponsorship of West Germany. European MPS activities include an active sounding rocket program, the development and use of Spacelab and related hardware, and the development of the reusable free-flying platforms, SPAS and EURECA. As a result of these activities, Europe will likely become an important source of information on the behavior of materials in microgravity. Japan has a small but active sounding rocket program directed toward MPS research; it has also used the Shuttle and Spacelab to carry out experiments. The Soviet Union has done a considerable amount of MPS research in its Salyut space station, but this research is unlikely to result in commercial competition for the United States.

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*Foreign ability to compete in space manufacturing will depend strongly on availability of the Shuttle to foreign users or on the development of suitable foreign launch vehicles and carriers.

At present, U.S. commitment to the Shuttle and to the development of an MPS science community, as well as NASA's encouragement of certain commercial space activities, have given U.S. industry a technological advantage. This advantage could diminish over the next decade as foreign access to space becomes more routine and the advantages and limitations of microgravity technology become more widely known.

MPS research and hardware development in Europe and Japan, in addition to raising the potential for future commercial competition, have made these countries valuable partners for international cooperation. Considering the current limited understanding of MPS and the high cost of investigating this technology, international cooperative activities would offer the benefit of expanding the base of knowledge while sharing costs. The United States should encourage international cooperation in basic scientific investigations or in areas in which the United States can benefit from foreign research (e.g., basic biomedical research and research in solidification). It should proceed cautiously in areas that might have near-term commercial applications or in which the United States holds a clear technological lead (e.g., continuous flow electrophoresis and containerless processing).

Any decision to increase Government support for MPS research should probably include increases in funding for international cooperative activities such as formal and informal exchanges of scientific personnel and information, and sharing of facilities such as the Shuttle, Spacelab, and European- and Japanese-built hardware. **Joint research projects such as the International Microgravity Lab proposed by NASA, which would allow the cooperative use of the Shuttle and foreign MPS hardware, seem to offer significant benefits and savings to NASA and the U.S. taxpayer.**

It is impossible to predict the future size or vitality of the markets for MPS products, services, and equipment. Although in the near-term, a few commercial MPS products will be developed, the long-term potential of microgravity research will not be known until substantially more research has been accomplished. The potential for developing a U.S. MPS industry depends on: continued Government-funded basic research; the availability of reliable, low-cost space transportation; and access to medium- or long-term MPS facilities such as free-flyers or a space station. It depends most on the discovery of commercially viable MPS products.*

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*McDonnell Douglas and Johnson & Johnson have been working since 1977 on processes to develop marketable pharmaceuticals. They hope to market their first product manufactured in space by 1987.

SPACE SCIENCE

Cooperation

Cooperation between countries in space science continues to be a major source of cultural, economic, political, and social benefits. Cooperation occurs in a variety of modes—among individuals, institutions, and governments. The Infrared Astronomical Satellite (IRAS), by which several major astronomical discoveries were made recently, is an excellent example of the high level of science that cooperative ventures can achieve.

Exploratory missions in astronomy and planetary science are increasingly complex and expensive. Although political considerations are important, the major driving force behind large cooperative space science projects will continue to be the prospect of sharing costs. Yet the complexity of such missions makes joint management by different governments, space agencies, and research institutions difficult. For this reason, international cooperative missions in which costs are shared should be designed so as to keep the management as simple as possible.

Now that ESA and Japan are able to mount major interplanetary missions, the terms of international cooperation have changed. In the International Halley Watch, for example, the United States has assumed a supportive, rather than a leading, role. **This change from its accustomed role reflects a recognition that the United States need no longer rely solely on unilateral efforts to maintain momentum in space science generally. The United States can now anticipate some return on our earlier investments in the space science programs of our cooperative partners.**

Whatever part the United States assumes in cooperative space science activities, it is extremely important for the United States to adhere to its cooperative agreements. As a case in point, the U.S. decision in 1981 to reduce substantially its participation in the International Solar Polar Mission continues to be named as an example of the difficulties involved in cooperating with the United States.

Competition

It is difficult to speak of direct competition in space science, at least among Western nations, as every nation's plans are known well in advance and there is little to be gained from duplicated research. (This was part of the reasoning behind the U.S. decision not to send a spacecraft to Halley's Comet.) Relative prestige is primarily a function of previous accomplishments and available resources.

Space science is also one way in which the United States demonstrates its leadership in space technology. **Although the United States maintains a leadership position in space science, as other nations gain greater experience, the United States faces increased competition in certain subfields of space science from ESA, Japan, and the Soviet Union.** One way in which the United States can maintain its broad base of knowledge and technology, while minimizing costs, is to continue to cooperate with other

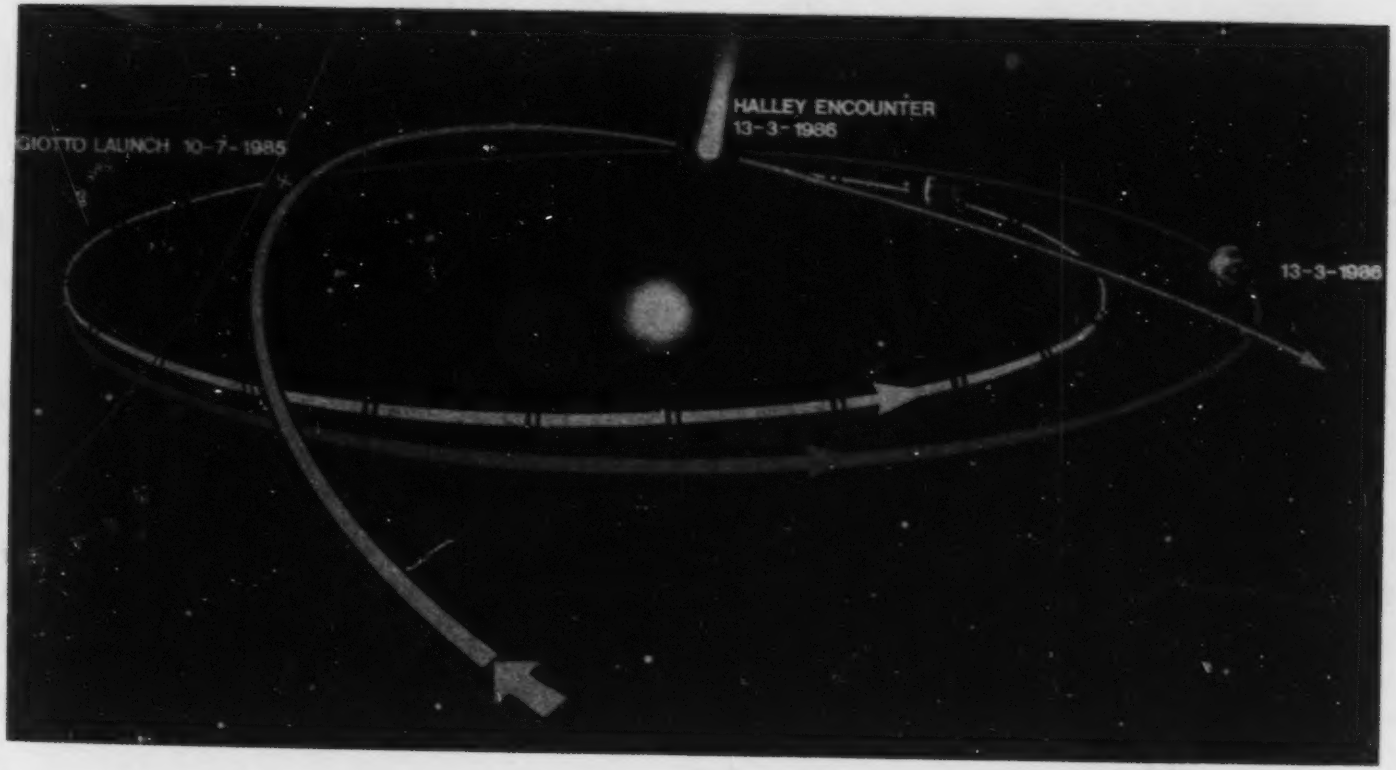
GIOTTO LAUNCH 10-7-1985
HALLEY ENCOUNTER
13-3-1986
13-3-1986

Photo credit: European Space Agency

The European Space Agency's Giotto comet probe is expected to pass within 100 to 500 kilometers of Halley's Comet. Data from the Soviet Vega probes to Venus, gathered and processed by NASA, will help to guide Giotto to a rendezvous with the comet countries, and to be aggressive in proposing experiments for foreign spacecraft.

Another competitive aspect of space science, and one which is fairly new, is the competition for cooperative partners on scientific missions. The Soviet Union has used such cooperation as a way to branch out from its Intercosmos base of Soviet bloc countries, to extend its influence, and to acquire needed scientific/technological expertise. The recent flight of an Indian cosmonaut aboard the Salyut 7 space station is one example. The Soviets are continuing an elaborate program of joint scientific projects with France. The United States must not overlook this competitive factor with regard to Third World interest in space science as a means of building the infrastructure necessary for space applications. **In the long run, the United States must remain cooperative in space science in order to remain competitive.**

The international market for space science equipment and services is relatively small. Because the United States has a well-developed infrastructure for supplying this market, it will continue to dominate the market for the foreseeable future.

U.S. CIVILIAN SPACE POLICY

Analysis of the issues raised by this assessment reveals that **two major problems dominate the organization and implementation of U.S. civilian policies toward space: 1) there is no national consensus about long-term goals and objectives in space, and 2) the political and economic dimension of space activities now exceed the purview of any one Government agency.**

Future Goals and Objectives

To maintain focus on the Nation's goals in space, periodic high-level review and discussion are required. In recent years, the Administration's examination of space policy has centered in special committees organized within the White House, and has been dominated by military and national security, as well as yearly budgetary, concerns. The current Administration's space policy committee, the Senior Interagency Group for Space (SIG-space) reflects this emphasis.* Neither the private sector nor several agencies** with long-standing responsibilities in the U.S. civilian space program are represented.

Observers generally agree that the United States needs to establish new specific civilian space goals. One possible mechanism for encouraging a national debate over the U.S. future in space is the National Commission on Space, as authorized in H.R. 5154.*** A National Commission on Space could, among other things, provide a public forum for analyzing the needs of the Nation with respect to space. It could also help to develop a national consensus on new long-term goals and objectives.*

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*The Senior Interagency Group is composed of representatives from the Departments of Commerce, Defense, and State, and the Central Intelligence Agency, the Joint Chiefs of Staff, the Arms Control and Disarmament Agency, and NASA.

**For example the Departments of Agriculture and Interior, the National Science Foundation, FCC, and AID.

***Passed by Congress, June 28, 1984.

Given the widespread and expanding uses of space, the diversity of governmental and private users, and the increase in international commercial competition, a commission designed to recommend future policy should be as diverse and as broadly based as possible, and include members from the private sector. **The Commission should seek input from all the Government agencies with responsibilities in space, but remain independent of them.** In addition to recommending goals and objectives, the Commission should provide guidance for implementing its recommendations in the context of other national goals.

It will be important for the Commission to specify the relationship of new goals and objectives to other national goals, and to take account of the limitations, as well as the strengths, of space policy. Just as satellite communications have become integrated into the telecommunications industry, **so will other space technologies, as they mature, become integral parts of larger, nonspace industries. They will then gradually become less appropriate objects of space policy, and more appropriate objects of policies related to those industrial sectors they serve.**

It is inappropriate to use space policy (which provides direction about the future exploration and exploitation of space), for example, to make decisions on international trade in space-related goods and services in isolation from the U.S. Trade Representative, decide on the requirements of international satellite telecommunications in isolation from the FCC, or to plan international programs in isolation from the Department of State. Nor should space policy per se be used to guide the overall planning of operational Government systems. For example, as the long debate over the Landsat program has demonstrated, systems that are expected eventually to provide continuing services should be planned primarily by those who will be expected to provide the technology, and use and pay for services.

Organizing for Space Activities

In the past, what this Nation sought to accomplish in space was achieved by NASA within the broad principles and goals of the 1958 National Aeronautics and Space Act (NAS Act). Today, the increase in foreign and commercial activities means that other Government agencies (not mentioned in the NAS Act) now play a greater role in space. Already, the Departments of Agriculture, Commerce, Interior, and State, and the FCC, in conjunction with the private sector, manage most of the civilian applications of space technology. Recently the Department of Transportation (DOT) has been charged with promoting and regulating private sector space transportation systems.** **Strengthening U.S. competition with other**

---

*For an initial suggested list of such goals and objectives, see *Civilian Space Stations* (Washington, DC: U.S. Congress, Office of Technology Assessment, in press.)

**This assignment was made by President Reagan, Congress is now considering DOT's role in space transportation.

space-capable nations, or improving our ability to cooperate effectively, will require careful attention to the means of coordinating the activities of all of the Federal agencies with an interest in space with each other and with those of the private sector.

For example, this year's authorization legislation for NASA, H.R. 5154, amends the NAS Act to include a provision directly related to private sector activity in space:

> The Congress declares that the general welfare of the United States requires that the National Aeronautics and Space Administration seek and encourage, to the maximum extent possible, the fullest commercial use of space.

This provision directs NASA to involve itself in the commercial exploitation of space. **Yet NASA, by itself, is not well-equipped either to choose specific technologies for commercial exploitation or to foster the creation of new space industries.**

Seeking the fullest commercial use of space will require the direct involvement of those agencies versed in domestic commerce and regulation, international trade, and foreign affairs. **Government decisions regarding commercial space activities must above all be responsive to how the actual markets and industries involved work, and how international competition in space industries relates to international competition generally.**

In order to foster effective coordination, it will be important for Congress to designate clearly a lead agency for regulating a particular private sector activity. As new specific commercial space technologies mature, agencies other than NASA should be given primary responsibility for their oversight. The recent designation of DOT as the lead agency for private space transportation services indicates how the responsibilities for overseeing commercial space activities could be organized in the future.

The ability to pursue foreign policy objectives through cooperative space activities is hampered by the fact that no single agency has control over U.S. cooperative activities. Currently, the responsibility for cooperative international civilian space activities is divided among the Department of State, Department of Commerce, FCC, and NASA. The conduct of foreign policy is the responsibility of the Department of State, which has little expertise in space. If the United States wishes to use its civilian space activities to pursue U.S. foreign policy interests more aggressively, it will be important to expand the Department of State's space expertise.

Cooperation and Competition as Part of Policy

Cooperation and competition with other nations are not ends in themselves; they are merely tools with which to carry out long-term national security, political, and economic objectives. Nations have cooperated for humanitarian reasons, for example, in the U.S. Advanced Telecommunications Satellite experiments of the 1970s or the current U.S., Canadian, French, and Soviet Sarsat project. They have also cooperated to obtain technology or resources which would later allow them to compete economically or politically. Examples of this include ESA's work with the United States on Spacelab and NASA's cooperative programs involving remote sensing. European competition with the United States in launch services and remote sensing has helped to establish Europe as an important partner for cooperation with other nations.

If the United States wishes to retain an international leadership role in the continued exploration, development, and use of space it must be effective at both cooperation and competition. A clear understanding of long-term national goals and objectives and a workable division of responsibilities and coordination among the various Federal agencies as well as between Government and the private sector will therefore be essential.

NOTE: Copies of the full report "International Cooperation and Competition in Civilian Space Activities" can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

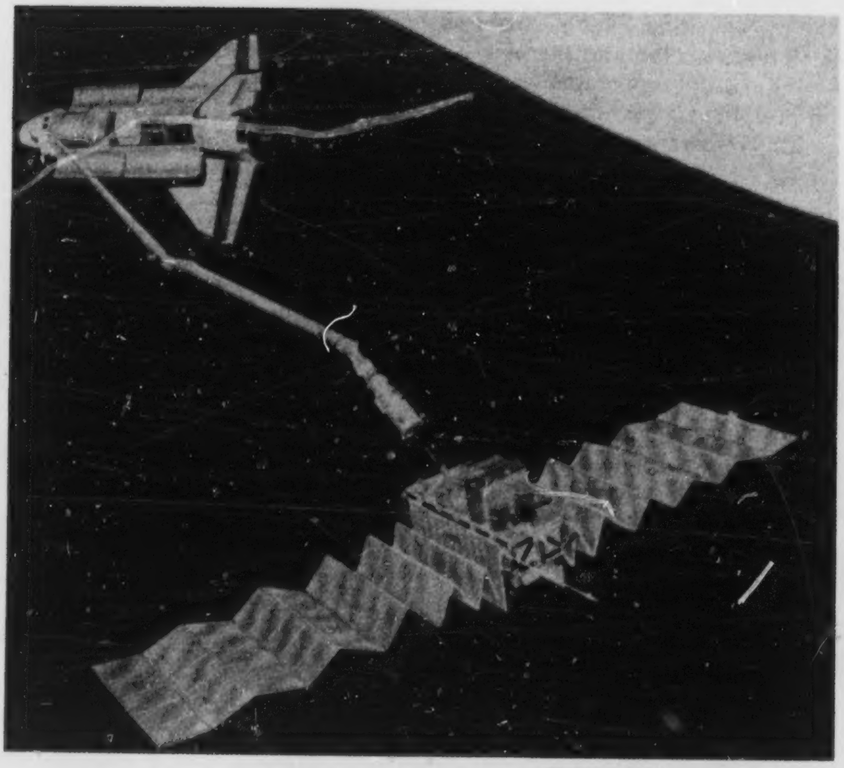


Photo credit: European Space Agency

Artist's view of the European-developed EURECA space carrier being deployed from the U.S. Space Shuttle with the Canadian-built remote manipulator arm

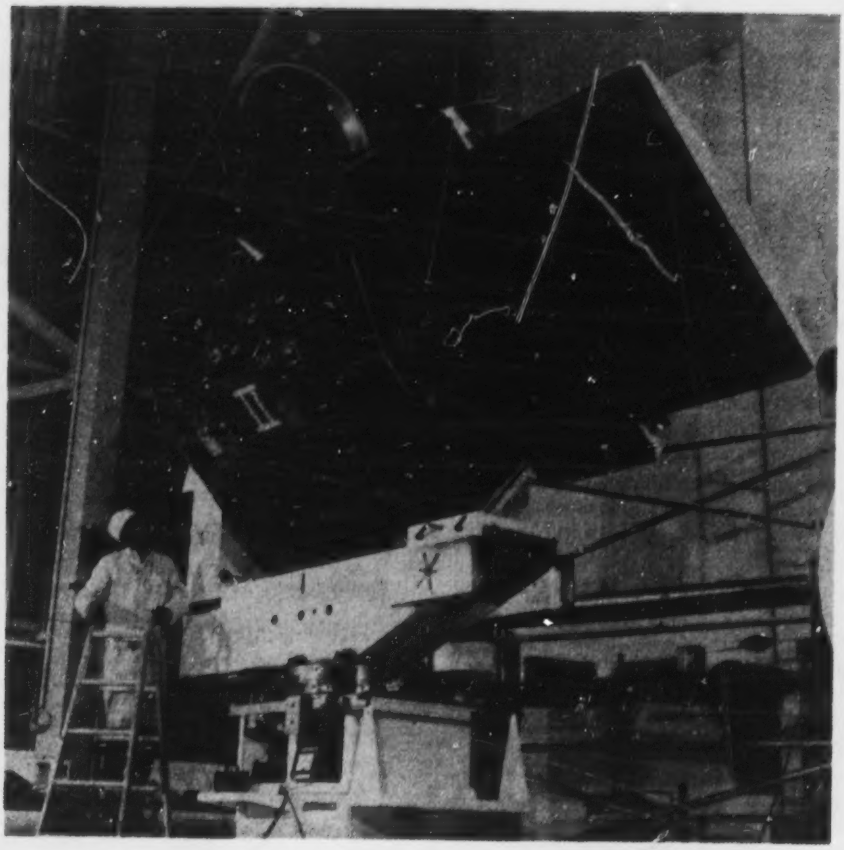


Photo credit: European Space Agency

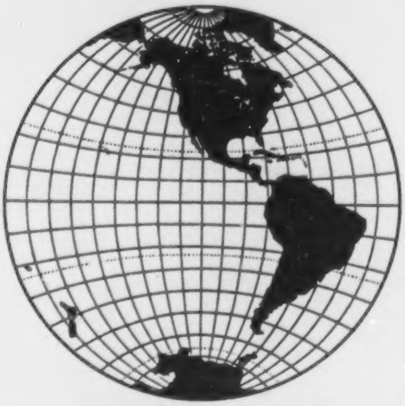
The ESA EXOSAT satellite undergoing tests. EXOSAT has observed a number of X-ray emitting sources in the Milky Way galaxy and beyond

Assessments in Progress as of July 1984

Technology and the American Economic Transition
Strategic Responses to an Extended Oil Disruption
Potential U.S. Natural Gas Availability
Load Management and Generating Technologies for Electric Utilities in the 1990's
Technologies for Surface Mine Reclamation on Western Federal Lands
Technologies To Reduce U.S. Materials Import Vulnerability
Technology and Structural Unemployment: Retraining Adult Displaced Workers
Cleanup of Uncontrolled Hazardous Waste Sites Under Superfund
Strategic Command, Control, Communications, and Intelligence Systems
Technology Transfer to the Middle East
New Ballistic Missile Defense Technologies
Technology, Public Policy, and the Changing Structure of American Agriculture
Evaluation of Agent Orange Protocol
Health and Safety Controls in the Workplace
Federal Policies and the Medical Devices Industry
Status of Biomedical Research and Related Technology for Tropical Diseases
Blood Policy and Technology
Medical Technology and Diagnosis Related Groups: Evaluating Medicare's Prospective Payment System
Technology and Indian Health Care: Effectiveness, Access, and Efficiency
Physicians and Medical Technology: Use, Cost, and Payment Methods
Technology and Aging in America
Alternatives to Animal Use in Testing and Experimentation
Reproductive Hazards in the Workplace
Effects of Information Technology on Financial Services Systems
Information Technology Research and Development
Information and Communication Technologies and the Office
Federal Government Information Technology: Administrative Process and Civil Liberties
Intellectual Property Rights in an Age of Electronics and Information
Managing Commercial High-Level Radioactive Waste
Technologies To Measure, Monitor, and Mitigate Groundwater Contamination
Technology for Developing Offshore Oil and Gas Resources in Hostile Environments
Technologies for Disposing of Waste in the Ocean
Airport System Development
Civilian Space Stations
Technology, Innovation, and Regional Economic Development
Hazardous Materials Transportation: Technology Issues

APPENDIX II

NESDIS
International Activities



July
1984

NESDIS INTERNATIONAL ACTIVITIES

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I. INTRODUCTION

This document summarizes the current international activities of the National Environmental Satellite, Data, and Information Service of the National Oceanic and Atmospheric Administration. Virtually every element of NESDIS programs includes international activity of some sort. The NESDIS Data Centers are part of a global data network. The NESDIS satellites provide data of the entire globe in collaboration with other nations.

NOAA's satellite and information programs are highly dependent upon successful international cooperation. NESDIS' international partners play an essential role, and NESDIS programs could not be carried out without their assistance. Successful international programs involve sharing both benefits and responsibilities. The NOAA activities meet this criterion. NOAA is an agency with global interests and responsibilities in the oceans and atmosphere. This leads inevitably to cooperative international programs in space applications. This publication is a first step in documenting the breadth and extent of that international cooperation.

For further information, please contact the NESDIS International and Interagency Affairs Unit, Federal Office Building #4, Mail Stop D, Washington, D.C. 20233, telephone 301-763-2418.

II. OVERVIEW

The National Environmental Satellite, Data, and Information Service (NESDIS) operates three civil operational remote sensing satellites and four data centers. The NESDIS satellites are the polar-orbiting NOAA series of environmental satellites, the Geostationary Operational Environmental Satellites (GOES), and the Landsat earth observations series. The NOAA polar-orbiting satellites monitor weather and surface conditions over the entire globe daily. Imagery, quantitative data, data collection, and search and rescue capability are included in the polar satellite instrument complement. Data are transmitted continuously to direct reception facilities around the world, as well as to NOAA ground control and data acquisition stations. Two geostationary weather satellites observe the Atlantic Ocean and East and Gulf Coasts, and the Pacific Ocean and West Coast. These spacecraft provide imagery, soundings, and act as communications relays for data from the polar satellites, and for data from remote data collection platforms. Landsat provides digital data of the earth's resources which are received in the U.S. as well as at a series of foreign ground stations.

NESDIS also includes four data centers: the National Climatic Data Center (NCDC), the National Oceanographic Data Center (NODC), the National Geophysical Data Center (NGDC), and the Assessment and Information Services Center (AISC). These facilities provide archival services, as well as training and applications research in their respective areas.

This document addresses international satellite activities, NESDIS participation in international organizations, data and information collection and data exchanges, cooperative programs, and training.

III. INTERNATIONAL SATELLITE ACTIVITIES

A. Polar-Orbiting Meteorological Satellites

1. Search and Rescue Satellite System (COSPAS/SARSAT)

The COSPAS/SARSAT program is a cooperative effort of the United States, the U.S.S.R., Canada, and France (COSPAS/SARSAT partners), along with Norway, Sweden, the United Kingdom, Bulgaria and Finland (investigator nations), to locate downed aircraft and surface vessels in distress.

The U.S. interagency SARSAT team is composed of NOAA (SARSAT Management Unit, External Relations Staff of NESDIS) and NASA, responsible for the demonstration and evaluation phase and technology development; the U.S. Coast Guard, responsible for maritime search and rescue (SAR); and the U.S. Air Force, responsible for inland SAR coordination. The U.S. interagency SARSAT team cooperates with the Department of National Defence of Canada and the Centre National d'Etudes Spatiales (CNES) of France to form the SARSAT Project team. The international SARSAT Project team, in conjunction with the U.S.S.R.'s Ministry of Merchant Marine (MORFLOT), participate in a cooperative effort known as the COSPAS/SARSAT Project.

The COSPAS/SARSAT System objective is to support SAR operations by providing services from satellites which are in low altitude, high inclination orbits to facilitate the detection and location of distress signals. The detection and location are accomplished by relaying, via satellite, distress information from aircraft and ships to ground facilities which complete information processing and transmit position locations to rescue services. Since the program began in 1982, the satellite system has materially contributed to saving more than 246 lives.

The COSPAS/SARSAT system is composed of four basic elements:

a. ELT/EPIRB*: These small emergency transmitters are designed to transmit distress data to the COSPAS and SARSAT satellites on frequencies of 121.5 MHz, 243 MHz, and 406 MHz.

b. SPACECRAFT: The optimum system calls for a constellation of four satellites, two U.S.S.R. satellites and two U.S. satellites. SARSAT instrumentation consists of a repeater provided by Canada and a processor provided by France. To date three U.S.S.R. COSMOS series navigational spacecraft equipped with COSPAS instrumentation and one U.S. advanced TIROS-N (NOAA 8) environmental spacecraft equipped with SARSAT instrumentation have been launched. The NOAA spacecraft which failed in mid-June will be replaced in October 1984. NOAA has plans to launch SARSAT packages on future environmental spacecraft.

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* ELT - Emergency Locater Transmitter, used on aircraft
EPIRB - Emergency Position Indicating Radio Beacon, used on surface vessels

c. LOCAL USER TERMINAL (LUT): The LUT is a ground station which receives the satellite relayed distress messages. These distress signals are then processed at the LUT to determine the location of the party in distress which is then transmitted to a Mission Control Center (MCC). LUTs are located in the U.S. (3), the U.S.S.R. (3), Canada, France, the United Kingdom (406 MHz only), and Norway.

d. SYSTEM CONTROL AND COORDINATION: System control and coordination are accomplished by the MCC in each of the participating countries (U.S., U.S.S.R., Canada, and France). The USMCC acts as the single point of contact for the SARSAT parties in coordinating system operations with the COSPAS MCC.

2. ARGOS Data Collection and Platform Location System (DCPLS)

The ARGOS Data Collection and Platform Location System (DCPLS), or ARGOS DCS, is a cooperative project among the Centre National d'Etudes Spatiales (CNES) of France, NASA, and NOAA. The system provides a means to locate and collect environmental data from moving and fixed platforms located anywhere on the earth's surface.

The ARGOS system is composed of:

- approximately 400 fixed and moving platforms provided by about 17 countries, each equipped with sensors and a platform transmitter terminal;
- two NOAA polar-orbiting environmental satellites, each equipped with an onboard data collection system (DCS) ensuring platform message reception, processing, and retransmission; and
- the ground data processing centers.

CNES provides the DCS equipment flown on the NOAA satellites at no charge to the United States. The NOAA satellites receive messages as they pass over the platforms and record them for playback to the three telemetry ground stations located at Gilmore Creek, Alaska, and Wallops Island, Virginia, (NOAA), and Lannion, France (CNES). The data are then transmitted to the NESDIS Center in Suitland, Maryland, and relayed to the CNES Space Center in Toulouse, France, where the ARGOS Data Processing Center is located. The processing consists mainly of formatting the data and computing the locations of the data collection platforms located around the globe.

CNES, NOAA, and NASA are bound by a Memorandum of Understanding (MOU), signed in 1974 and modified in 1984, which defines the responsibilities of each agency. An ARGOS Operations Committee, co-chaired by CNES and NOAA, oversees management of the operation of the ARGOS system.

The following are products and services provided through the use of the ARGOS DCS:

- the relay of in-situ observations of surface and upper level ocean conditions and surface weather conditions. The location of moving platforms provides information on surface currents for buoys, or middle or upper level winds for balloons.
- the capability to track the movement of oceanic research ships and marine animals in research programs.
- the relay of in-situ environmental data from those platforms in the Arctic and Antarctic that are not observable from the data collections system on the geostationary GOES satellites. These data provide vital inputs to analyses of weather patterns transiting the polar regions.
- ARGOS-equipped buoys are placed in regions where ocean currents are expected to carry icebergs into shipping lanes. Also, buoys are attached to already-drifting icebergs, to verify berg-drift forecasts based on ocean current rates.

3. United Kingdom Stratospheric Sounding Unit

Under an MOU signed in September 1974, the United Kingdom Meteorological Office provides a Stratospheric Sounding Unit (SSU) which NOAA flies on its NOAA polar-orbiting satellites, as part of the TIROS Operational Vertical Sounder (TOVS). In exchange, NOAA transmits raw and processed TOVS data to the U.K.. The SSU is a three-channel instrument with 147 km resolution, which measures temperatures in the stratosphere. Together with the other elements of TOVS, vertical temperature profiles are derived, and used for global numerical modeling of the atmosphere. Discussions are underway with the U.K. on provision of an Advanced Microwave Sounding Unit (AMSU) for NOAA-K,L, and M.

B. Geostationary Meteorological Satellites

1. Coordination on Geostationary Meteorological Satellites (CGMS)

The CGMS is composed of the current and prospective geostationary meteorological satellite operators from the European Space Agency (ESA), India, Japan, U.S.A., and U.S.S.R., as well as representatives from the WMO, which participates in the activities of the CGMS in its endeavor to promote the development of a global meteorological observing system. Dr. John McElroy, Assistant Administrator of NESDIS, is the Senior U.S. Representative to the CGMS.

The first discussions directed toward coordination of nationally-operated remote sensing satellites began in September 1972, when representatives of the United States (NOAA), the European Space Research Organization (now the European Space Agency) and Japan (Japanese Meteorological Agency) met to consider complementarity and compatability among these agencies' planned geostationary meteorological satellites. This initial meeting led to the establishment of the CGMS, an informal, technical group through which program/project managers of agencies pursuing plans for such missions are able to discuss common interests relating to the design, operation and use of their spacecraft. The U.S.S.R. and India also initiated development of geostationary meteorological satellites and joined CGMS in 1973 and 1978, respectively.

CGMS was organized to develop technical recommendations which are not binding on satellite operators. CGMS has served as a forum through which national plans could be informally rationalized and harmonized to the point where participating agencies could, if they wished, pursue development of complementary and compatible space segments. As a result of CGMS, while the geostationary meteorological satellites remain independently designed and developed, they also meet common meteorological mission objectives and have produced certain compatible data products for users around the world.

The work of CGMS since 1973 has been carried out principally through two technical working groups which work closely together and meet simultaneously or jointly. The Operations Working Group is concerned with the operational aspects of the programs, especially data processing and dissemination, and reflects knowledge of user needs in identifying possible areas where commonality among planned systems would be of value to users worldwide. Matters such as compatible data formats, standard transmission frequencies, compatible data collection platform standards, and complementary orbits have been discussed by this group. The System Engineering Working Group has considered the technical feasibility of suggestions developed by the Operations Working Group and has then derived possible means of implementing those suggestions deemed to be both technically feasible and cost-effective, and which are also likely to be implementable from the point of view of policy, cost and scheduling.

2. GOES Data Collection System (DCS)

Two Geostationary Operational Environmental Satellites (GOES) observe the North and South American continents. The Data Collection System (DCS) on GOES monitors, collects, and retransmits environmental data from data collection platforms (DCPs) at remote earth locations. The information is used to provide storm and flood warnings and forecasts, and for water resource management and other hydrological applications.

Twenty-four users in nine foreign countries operate DCPs. In addition, five foreign direct readout stations are equipped to receive the DCP messages directly from the spacecraft.

The following is a list of the foreign DCS users, their applications of the system, and the dates the Memoranda of Agreement (MOA) between NOAA/NESDIS and the users are in effect.

Country	User	Program
Argentina	Comision Nacional de Investigaciones Espaciales (CNIE) (MOA being renegotiated)	Relay of environmental data from Argentina and Antarctica to a direct readout station in Mendoza.
Bolivia	Servico Geologico de Bolivia (MOA 6/80-5/85)	Relay of meteorological and hydrological data from 2 remote sites in Bolivia.
Brazil	Instituto de Pesquisas Espaciais (INPE) (MOA 7/82-6/92)	Relay of hydrological data from 10 remote sites to a direct readout station.
Canada	Alberta Energy and Resources (MOA 9/82-8/87)	Relay of meteorological and hydrological data from more than 20 sites.
	Atmospheric Environment Service (AES) (MOA 12/80-11/90)	Relay of meteorological data from more than 20 remote sites.
	British Columbia Hydroelectric (MOA 3/83-2/88)	Relay of hydrometeorological data from more than 20 remote sites for use in water management of rivers in B.C.

Country	User	Program
Canada (cont'd)	British Columbia Ministry of Transportation (MOA 10/83-9/88)	Relay of meteorological data from 2 sites prone to avalanches in southern B.C.
	Dome Petroleum (MOA 9/79-8/89)	Relay of meteorological data from stations on ice flows in Beaufort Sea to assist AES in supporting public forecasting in Canadian Archipelago.
	Environment Canada Inland Water Directorate (MOA 6/80-5/90)	Relay of hydrological data used in flood control and water management.
	ESSO Resources, Canada, Ltd. (MOA 12/81-11/86)	Relay of meteorological and oceanographic data to assist AES in providing public forecasts in Davis Strait between Canada and Greenland.
	Marine Sciences and Information (MOA 8/81-7/91)	Relay of wave measurement data from oceanic areas adjacent to Canada for storm warnings, off-shore drilling platform design, and input in sea state models.
	Ontario Hydroelectric (MOA 4/80-3/85)	Relay of hydrological data for use in flood control and water management.
	Ontario Ministry of Natural Resources (MOA 9/82-8/87)	Relay of hydrometeorological data for use in river forecast system models used for flood forecasting and water management.

Country	User	Program
Canada (cont'd)	Petro Canada (MOA 11/80-10/90)	Relay of environmental data from Canadian Archipelago for AES use in providing public forecasts.
	Quebec Environment (MOA 10/80-9/90)	Relay of hydrometeor-meteorological data from remote areas in Quebec for use in water management.
	Saskatchewan Research Council (MOA 4/80-3/85)	Relay of environmental data used to monitor atmospheric and water contaminants near Dubawnt Lake, Saskatchewan.
	Trans Canada Pipelines (MOA 9/82-8/87)	Relay of meteorological data for AES use in providing public forecasts in the Arctic and information for designing an Arctic Port facility on Ellef Ringnes Island.
Chile	University of Chile (MOA 6/83-6/88)	Relay of environmental data from Chile and Antarctica to a direct readout station in Santiago.
Ecuador	Centro de Levantamientos Intergrados de Recursos Naturales por Sensores Remotos (CLIRSEN) (MOA 10/83-9/88)	A test and later an operational program to relay environmental data in remote areas to a direct readout station.

Country	User	Program
Mexico	Meteorologico Nacional (MOA 1984-1994)	Relay of meteorological data from several remote islands to a direct readout station in Mexico City for use in improving weather forecasting services.
Panama	Instituto de Recursos Hidraulicos y Electrification (MOA 6/83-5/88)	Relay of hydrological data from remote river basins for use in water management.
United Kingdom	British Antarctic Survey (MOA 10/82-9/87)	Relay of meteorological data (surface, ship, upper air) from stations on or near the Antarctic Continent.

C. Direct Readout Services

The direct readout services program enables government agencies, academic and scientific institutions, commercial firms, and private citizens all over the world to obtain and use data from NOAA's environmental satellites without going through NOAA's own central data acquisition and processing facilities. These services include the APT (Automatic Picture Transmission), HRPT (High Resolution Picture Transmission), and DSB (Direct Sounder Broadcast) services, all from polar orbiting NOAA satellites, and the WEFAX (Weather Facsimile) and VISSR (Visible-Infrared Spin Scan Radiometer) services from the geostationary GOES satellites.

There at least 1,000, and possibly as many as 3,000-4,000, environmental satellite direct readout stations of one type or another in operation in over 120 countries. The direct readout services are used for local and regional operational public, aviation, maritime, and agricultural weather forecasting, for sea and lake ice reconnaissance, snow cover and snow melt observations, ocean temperature and current studies, and many other purposes. They support, among other activities, locust control efforts in Africa, petroleum exploration in the Arctic, and river, lake, and ocean fishing activities around the world. In some developing countries, direct readout of environmental satellites provides the only opportunity for involvement in space activities; often, a single readout station in such countries provides observations to several other government agencies within that country. In the United States and elsewhere, a single commercial firm receiving data via direct readout may provide tailored satellite products to hundreds of customers or to thousands of viewers through cable TV links.

Operators of satellite direct readout receiving stations are under no legal, financial, or political obligation to any federal agency in the United States to report the purchase, construction, or operation of a station to receive environmental satellite direct readout services. For this reason, the lists of countries having such capabilities may not be entirely complete.

1. APT (Automatic Picture Transmission)

The APT services are provided by the polar orbiting NOAA satellites and copied by well over 1,000 users worldwide. Two channels of data are sent continuously, as a VHF signal, as the satellite orbits the earth. The signals can be received on very low-cost equipment and displayed as an image, or converted into digital products showing cloud, ocean, or land temperature values.

Primary users are government meteorological agencies in developing countries, and ships or land stations in polar latitudes where geostationary satellite signals cannot be received.

A list of countries with APT receiving capabilities follows:

COUNTRIES/LOCATIONS WITH APT FACILITIES

Afganistan
Algeria
Angola (status unk.)
Antarctica
Argentina
Australia
Austria
Azores
Bahamas
Bahrain
Bangladesh
Barbados
Belgium
Bermuda
Bolivia
Brazil
Bulgaria
Burma
Cambodia (stat. unk.)
Cameroon
Canada
Canary Islands
Chile
Colombia
Costa Rica
Curacao
Czechoslovakia
Dominican Republic
Ecuador
Egypt
El Salvador
Ethiopia
Fiji
Finland
France
French Guiana
Gambia
German Dem. Rep.
Germany, Fed. Rep. of
Ghana
Greece
Greenland
Guadeloupe
Guatemala
Guyana
Honduras
Hong Kong
Hungary
Iceland
India
Indonesia
Iran
Iraq
Israel
Italy
Ivory Coast
Japan
Jordan
Kenya
Korea (South)
Kuwait
Madagascar
Malaysia
Mali
Malta
Martinique
Mauritania
Mauritius
Mexico
Mongolia
Morocco
Mozambique
Nepal
Netherlands
Netherlands Antilles
New Zealand
Nicaragua
Nigeria
Norway
Oman
Pakistan
Papau New Guinea
Paraguay
People's Rep. of China
Peru
Philippines
Poland
Portugal
Romania
Saudi Arabia
Scotland
Senegal
Seychelles
Sierra Leone
Singapore
Somalia
South Africa
South Yemen
Spain
Sri Lanka
Sudan
Suriname
Sweden
Switzerland
Syria
Tahiti
Taiwan
Tanzania
Thailand
Trinidad and Tobago
Tunisia
Turkey
USSR
United Arab Emirates
United Kingdom
United States
Upper Volta
Uruguay
Venezuela
Vietnam, (stat. unk.)

Yugoslavia
Zaire
Zambia
Zimbabwe

2. HRPT (High Resolution Picture Transmission)

Like APT services, HRPT services are also provided continuously from polar orbiting NOAA satellites. However, there are several differences between these services; five, rather than two, channels are sent, and resolution of features is considerably higher. The data are also sent on a higher frequency, and much more expensive equipment is needed to receive and process the signals.

There are at least 80 HRPT stations in operation around the world, 23 operated by U.S. government or military services, and the rest in operation in 49 countries. Their primary application is to provide more sophisticated observations of meteorological and other geophysical phenomena than can be obtained with APT readout.

A list of countries with HRPT receiving capabilities follows:

COUNTRIES/LOCATIONS WITH HRPT RECEIVING CAPABILITIES
JULY 1984

Bangladesh
Belgium
Brazil
Canada
Czechoslovakia
Denmark
France
Germany, Fed. Rep. of
Greenland (Can./Den.)
India
Indonesia
Iran
Italy
Japan
Korea (South)
Malaysia
Mongolia
Netherlands
New Zealand
Norway
People's Rep. of China
Saudi Arabia
Singapore
South Africa
Sweden
Switzerland
Taiwan
Thailand
Tunisia
United Kingdom
United States
USSR
Yemen (South)

3. DSB (Direct Sounder Broadcasts)

Along with other types of observations, both the polar and geostationary satellites transmit realtime digital data via direct readout that can be converted into atmospheric temperature and humidity profiles, or soundings, but only the data from the polar satellites are used operationally at this time. (Geostationary soundings are being acquired experimentally; operational transmissions will begin in 1986). The instrument used to provide soundings from polar satellites is the TIROS Operational Vertical Sounder, or TOVS. The primary users are the national meteorological services of the United States and (at least) seven other countries.

Satellite atmospheric soundings, like their radiosonde counterparts, enable meteorologists to observe the major circulation patterns in the atmosphere. From these observations, the stability of the atmosphere also can be determined; areas of instability, conducive to thunderstorm development, can be detected. Large-scale air masses can be identified and tracked, and many other meteorological phenomena can be observed and studied.

Signal reception from instruments that provide the Direct Sounder Broadcast services is a relatively easy task, but retrieval and processing of the data requires quite sophisticated software and a comprehensive understanding of the physical processes that affect data reduction. For this reason, there are few stations or countries in the world presently utilizing the Direct Sounder Broadcast services. Those that do are listed below:

COUNTRIES/LOCATIONS WITH DSB RECEIVING/PROCESSING CAPABILITIES
JULY 1984

Australia
Canada
Germany, Fed. Rep. of
France
Japan
Poland
United Kingdom
United States

4. VISSR (Visible-Infrared Spin Scan Radiometer)

The VISSR instrument on the GOES spacecraft provides high resolution visible and infrared data approximately 20 minutes of each half hour. When these data are displayed in image form, atmospheric circulation patterns, as revealed by cloud forms, can be observed and their motions predicted; wind vectors can be plotted; sea and lake ice and snow cover can be mapped. In digital formats, sea surface temperatures, ocean currents, cloud heights, and land surface temperatures (such as those important to citrus growers) can be displayed.

At present, there are 21 active VISSR stations; 14 in the United States and 7 in other countries. Of the 14 in the U.S., seven are operated by government or military agencies, three by academic institutions, and four by commercial organizations. (Other military and commercial installations are planned in the near future). The seven non-U.S. VISSR stations are in five countries; all are operated by the meteorological agencies in those countries.

COUNTRIES/LOCATIONS WITH VISSR RECEIVING CAPABILITIES
JULY 1984

Argentina
Brazil
Canada
France
Mexico
United States

5. WEFAX (Weather Facsimile)

WEFAX services are provided through communications transponders on each of the three geostationary GOES satellites. Data are sent on a scheduled basis, and include five different products: processed images acquired from the GOES VISSR system and from the low resolution, global area coverage system on the NOAA satellites, selected National Weather Service weather charts, operational messages, and orbital prediction information for predicting the position of the polar satellites.

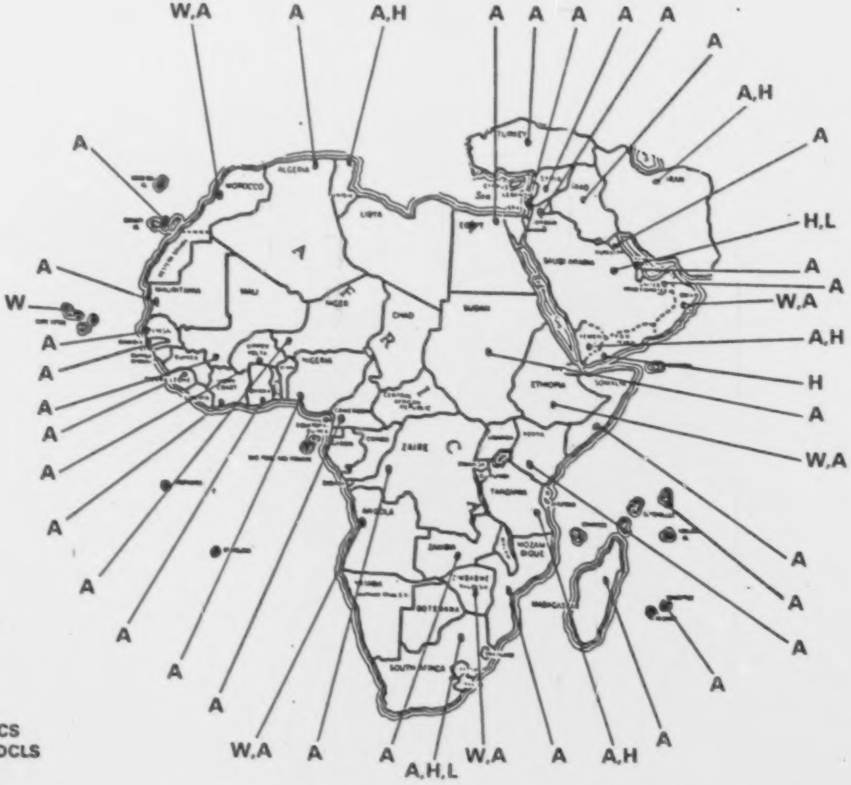
There are approximately 200 stations in 34 countries receiving WEFAX broadcasts from the GOES satellites. About 60 of these are amateur stations; the rest are operated by U.S. and foreign government or military agencies and commercial, scientific and academic organizations.

COUNTRIES/LOCATIONS WITH WEFAX RECEIVING STATIONS
JULY 1984

Argentina
Australia
Bahamas
Barbados
Bermuda
Bolivia
Brazil
Canada
Chile
Colombia
Costa Rica
Curacao
Dominican Republic
Ecuador
El Salvador
Fiji
France
French Guiana
Guadeloupe
Guatemala
Guyana
Honduras
Martinique
Mexico
Netherlands Antilles
Nicaragua
Paraguay
Peru
Tahiti
Trinidad and Tobago
United Kingdom
United States
Uruguay
Venezuela

Africa and the Middle East

June 1983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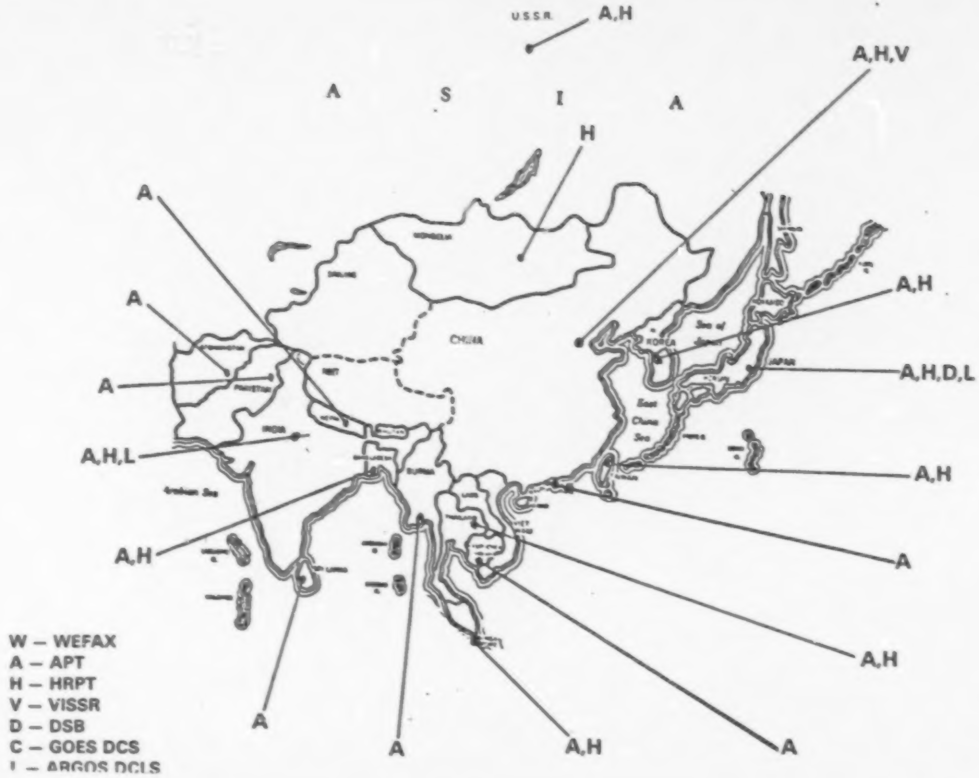
SUDAN
NIGERIA
SAUDI ARABIA
ETHIOPIA
SOMALIA
ZAIRE
TANZANIA
ANGOLA
ZAMBIA
MOZAMBIQUE
BOTSWANA
SOUTH AFRICA
MADAGASCAR

W – WEFAX
A – APT
H – HRPT
V – VISSR
D – DSB
C – GOES DCS
L – ARGOS DCLS

Asia

June 1983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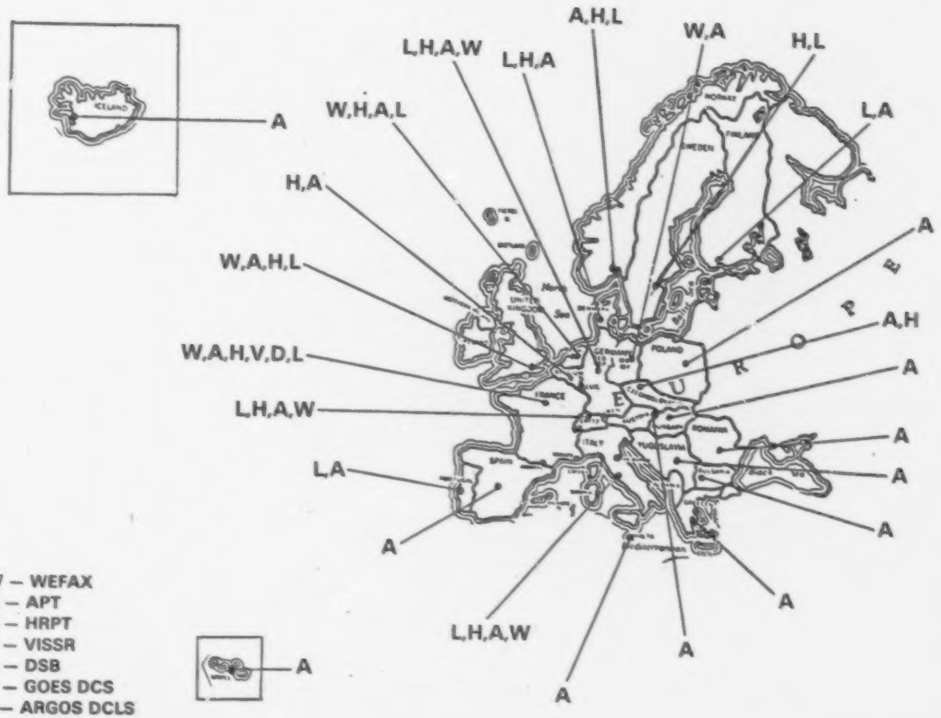
Sea of Japan
JAPAN
East China Sea
Arabian Sea
W – WEFAX
A – APT
H – HRPT
V – VISSR
D – DSB
C – GOES DCS
L – ARGOS DCLS

Europe

June 1983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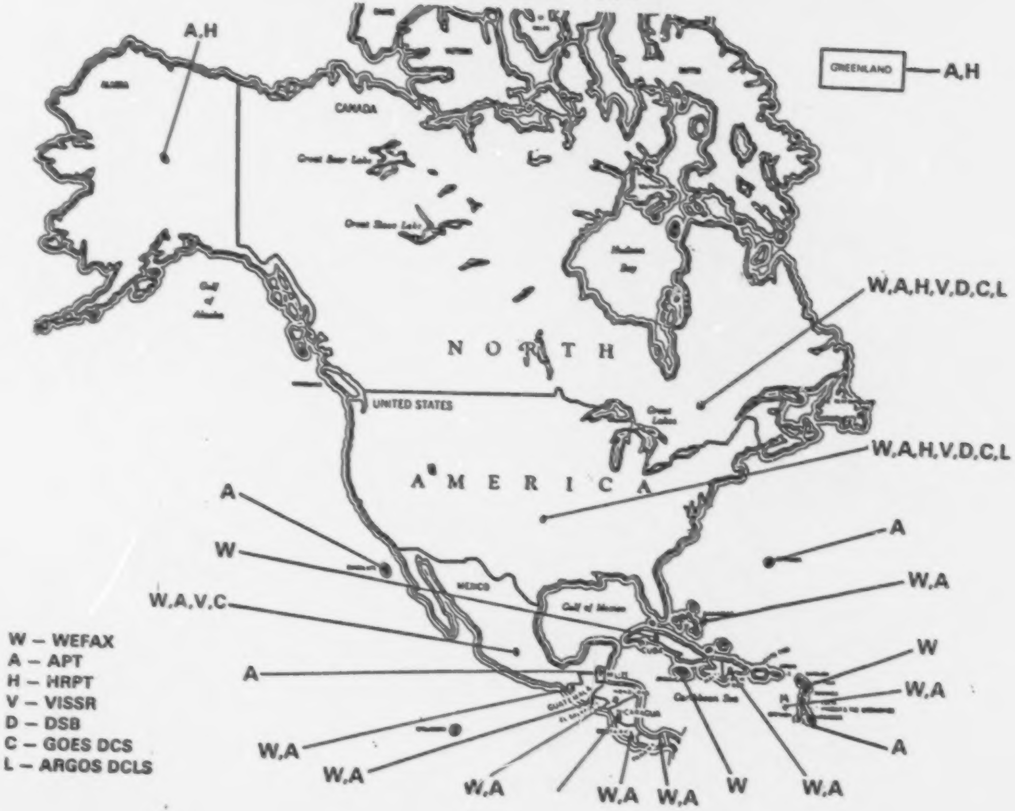
ICELAND
POLAND
FRANCE
ITALY
SPAIN
NORWAY
SWEDEN
FINLAND

W – WEFAX
A – APT
H – HRPT
V – VISSR
D – DSB
C – GOES DCS
L – ARGOS DCLS

North America and Central America

June 1983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CANADA
Great Bear Lake
Great Slave Lake
Hudson Bay
Gulf of Alaska
N O R T H
UNITED STATES
Great Lakes
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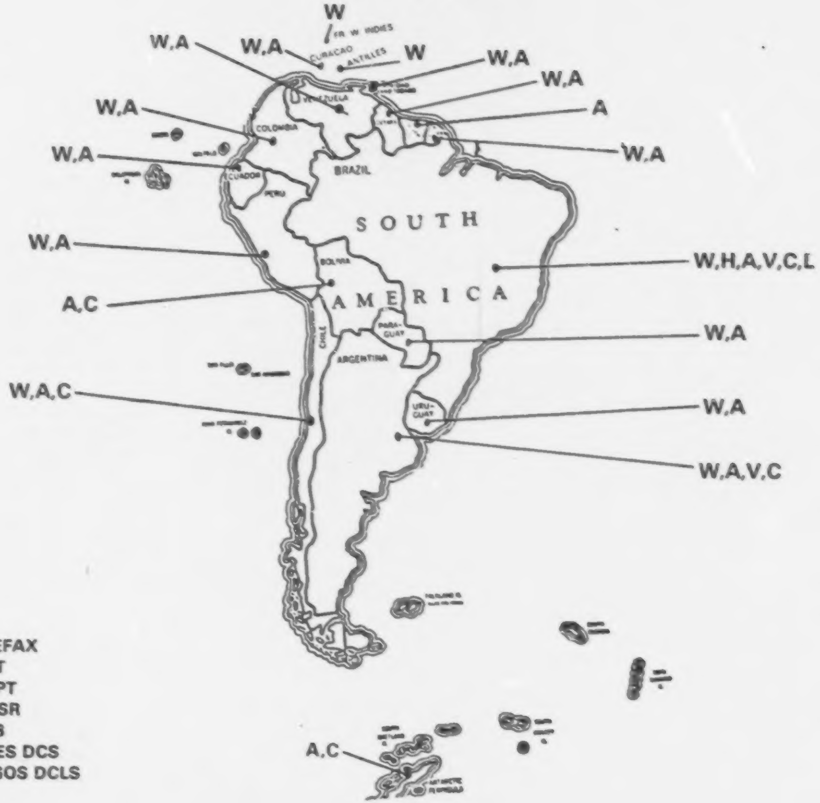
V – VISSR
D – DSB
C – GOES DCS
L – ARGOS DCLS

South America

June 1983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BOLIVIA
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GUAY
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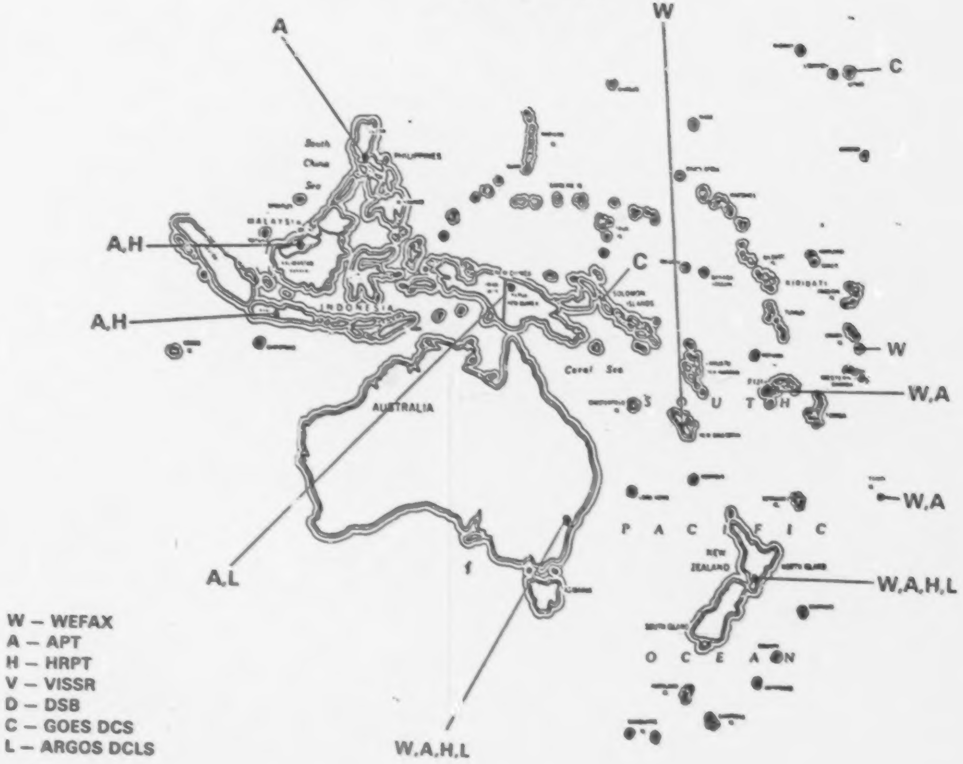
W – WEFAX
A – APT
H – HRPT
V – VISSR
D – DSB
C – GOES DCS
L – ARGOS DCLS

South Pacific

June 1983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South China Sea
PHILIPPINES
MALAYSIA
INDONESIA
AUSTRALIA
Coral Sea
SOLOMON ISLANDS
KIRIBATI
FIJI
NEW ZEALAND
SOUTH PACIFIC OCEAN
W – WEFAX
A – APT
H – HRPT
V – VISSR
D – DSB
C – GOES DCS
L – ARGOS DCLS

D. The Landsat System

NOAA/NESDIS operates the Landsat series of satellites, which provide sun-synchronous views of the globe for the monitoring of earth resources. Landsat 5, launched in May 1984, carries two sensors, the Multi-Spectral Scanner (MSS), an operational sensor which provides 80-meter resolution, and the experimental Thematic Mapper (TM) sensor, which has a resolution of 30 meters (120 meters in the thermal infrared band).

Data from Landsat are transmitted directly to ground receiving facilities around the world. The data are recorded, processed, archived, and distributed to users by the agency operating the station under terms of a Memorandum of Understanding (MOU) with NOAA. In exchange for access to Landsat data, station operators pay an annual access fee of $600,000 and a distribution fee on each data product sold. Data must be distributed on a non-discriminatory basis under the MOU.

Nine foreign nations and the European Space Agency (ESA) currently operate eleven Landsat ground stations. In addition, ground stations are being built or proposed in Bangladesh, Ecuador, Pakistan, the People's Republic of China, Saudi Arabia, and Upper Volta. The status of Landsat ground stations is outlined in a chart on the following page.

Landsat Working Groups:

- The Landsat Ground Station Operations Working Group (LGSOWG) was created in 1975 to serve as a forum for the exchange of ideas and information on land remote sensing activities. It affords an opportunity for Landsat ground station operators to meet and discuss problems as well as innovations in the use of Landsat data. LGSOWG meets once a year at different Landsat stations throughout the world to allow LGSOWG members the opportunity to learn about the host nation's Landsat facilities. Member countries include Argentina, Australia, Brazil, France, India, Indonesia, Italy, Japan, the People's Republic of China, South Africa, Sweden, Thailand, and the U.S.. Dr. John McElroy, Assistant Administrator for NESDIS, chairs the Group. The last meeting, held in 1983 in Washington, D.C., was attended by representatives from twelve countries.

- The Data Distribution and Marketing Working Group (DDMWG) is a subcommittee of the LGSOWG and acts to exchange information on data archiving, cataloguing and distribution; data sales statistics; marketing activities; and methods of better serving Landsat data users. It meets yearly as part of the LGSOWG.

- The Landsat Technical Working Group (LTWG) is a subcommittee of the LGSOWG to analyze and advise on technical aspects of Landsat ground station operations. It meets twice a year and is chaired by NESDIS (Edward Conlan, OSDPD).

FOREIGN LANDSAT GROUND STATIONS

Country	Ground Station Location	Operating Agency	Status of MOU	MSS Data Reception and Processing	TM Data Reception and Processing
Argentina	Mar Chiquita	Comision Nacional de Investigaciones Espaciales (CNIE)	Under negotiation	Yes	No
Australia	Alice Springs	Division of National Mapping, Department of Resources and Energy (DRE)	Signed March 1984	Yes	No
Brazil	Cuiaba	Instituto de Pesquisas Espaciais (INPE)	Signed May 1984	Yes	Yes
Canada	Prince Albert	Canada Centre for Remote Sensing (CCRS)	Under Negotiation	Yes	Yes
European Space Agency	Fucino, Italy Kiruna, Sweden	European Space Agency (ESA)	Signed February 1984	Yes	Yes
India	Hyderabad	National Remote Sensing Agency (NRSA)	Under Negotiation	Yes	Yes
Indonesia	Jakarta	Indonesian National Institute of Aeronautics and Space (LAPAN)	Under Negotiation	No (expected by 1985)	No
Japan	Tokyo	National Space Development Agency (NASDA)	Signed August 1983	Yes	Yes
South Africa	Johannesburg	National Institute for Telecommunications, Council for Scientific and Industrial Research (CSIR)	Signed October 1983	Yes	No
Thailand	Bangkok	National Research Council of Thailand (NRCT)	Under Negotiation	Yes	No

E. Multilateral Groups

1. Economic Summit Panel of Experts on Remote Sensing from Space

At the conclusion of the Seventh Meeting of the Economic Summit of Industrialized Nations held June 1982 in Versailles, France, the Heads of State established a Working Group on Technology, Growth and Employment to identify areas for further cooperation among the Summit Members (Canada, Federal Republic of Germany, France, Italy, Japan, United Kingdom, United States, and the European Communities). Satellite remote sensing was one of 18 topics chosen for discussion. Remote sensing from space is among the projects in which the United States is the chair, and NOAA/NESDIS was designated to be the U.S. expert point-of-contact.

The objectives of this panel are to exchange information on remote sensing programs and plans; and to coordinate remote sensing programs and plans with a view to avoiding duplication of efforts, fostering compatibility of activities to enhance the value of these programs in addressing global phemonena, and promoting more efficient use of budget resources.

In preparation for the 1983 and 1984 Summit Meetings, reports have been completed for each of the 18 topics for consideration by the Heads of State. Within remote sensing, participants have discussed potential collaboration in support of polar-orbiting meteorological satellites, participation in the satellite-aided search and rescue program, the coordination of present and future Earth observation satellites, including ocean satellites, and coordination of remote sensing training. NOAA/NESDIS and its counterpart agencies will continue to work on these cooperative projects and report on their efforts to the Summit Working Group.

2. International Earth Observation Satellite Committee (IEOSC)

This group was established through the discussions in the Economic Summit Panel of Experts on Remote Sensing from Space. In an effort to streamline remote sensing satellite coordination, the Summit experts agreed to establish a single group to replace the Coordination of Land Observing Satellites (CLOS), the Coordination of Ocean Remote Sensing Satellites (CORSS), and the multilateral meetings on long-term planning for remote sensing satellites. IEOSC will provide a forum for the informal coordination of technical parameters of environmental, land, and ocean satellites. This broad mandate is appropriate since many remote sensing satellites can no longer be identified with only one application. IEOSC membership is open to any country/agency with an approved remote sensing satellite program. The first meeting will be in September 1984. Participants are expected to include Canada, the European Space Agency, France, India, Japan, and the United States.

Cooperation in ocean sensing from space is a major area of attention in the IEOSC. By coordinating the planned Navy Remote Ocean Sensing Satellite (N-ROSS) with ESA's ERS-1 mission, the amount of ocean data will be three orders of magnitude greater than is currently available. Possible coordination of Canada's Radarsat and Japanese MOS-1 could further enhance ocean coverage. NOAA's role would be to serve as the U.S. focal point for data acquisition and dissemination, coordinating with U.S. civil and military agencies and providing liaison with international participants. The Gilmore Creek, Alaska, tracking station provides data reception capability for a large number of polar orbits, and may be used to receive ERS-1 and other ocean data.

3. International Polar-Orbiting Meteorological Satellite Group (IPOMS)

The 1984 Economic Summit endorsed the creation of IPOMS to explore mechanisms for increased international cooperation in and support for polar-orbiting meteorological satellites, and to ensure continuity of these satellites. Members of the group are agencies currently contributing or planning to contribute to the U.S. civil operational polar-orbiting meteorological satellite system. Contributions can be either direct funding or in-kind support. In considering possibilities for increased cooperation, the new group will consider the possible use of a polar-orbiting component of the future space station as a carrier of meteorological instruments. NOAA/NESDIS chairs this group. Canada, Federal Republic of Germany, France, Italy, Japan, United Kingdom, and the European Space Agency are being invited to participate. Australia and Norway are considering membership as well. The first meeting will be in November 1984.

IV. NESDIS PARTICIPATION IN INTERNATIONAL ORGANIZATIONS

A. World Meteorological Organization (WMO)

The World Meteorological Organization is a specialized agency of the United Nations. The WMO was created:

- to facilitate international cooperation in the establishment of networks of stations and centers to provide meteorological and hydrological services and observations.
- to promote the establishment and maintenance of systems for the rapid exchange of meteorological and related information.
- to promote standardization of meteorological and related observations and ensure the uniform publication of observations and statistics.
- to further the application of meteorology to aviation, shipping, water problems, agriculture and other human activities.
- to promote activities in operational hydrology and to further close cooperation between meteorological and hydrological services.
- to encourage research and training in meteorology and, as appropriate, in related fields.

The WMO is composed of the World Meteorological Congress, the supreme body of the organization; the Executive Council, which supervises the programs approved by the Congress; six Regional Associations, which coordinate meteorological and related activities within their respective regions; and eight Technical Commissions, responsible for studying meteorological and hydrological operational systems, applications and research.

NESDIS support of WMO activities includes transmitting satellite data on the Global Telecommunication System (GTS) on a routine basis, participating in working groups of the Technical Commissions, serving on the Executive Council Panel of Experts on Satellites, preparing and contributing to WMO documents, publishing climatic and world and regional data, and producing a cloud climatology global data set for the International Satellite Cloud Climatology Project.

The following describes the WMO programs that NESDIS supports:

1. World Weather Watch (WWW)

The World Weather Watch is the basic program on which nearly all other programs of the WMO depend. It is a coordinated global system designed to make available to Members, in a convenient form, the observational data and processed information they require for both operational and research purposes.

The Global Observing System (GOS) is the part of the WWW which is concerned with taking measurements and making other observations required to describe the state of the atmosphere and the related environment. The purpose of the GOS is to provide WMO Members with observational data from all parts ot the world for use both in operational and research work. In this task, the GOS is very closely related to the other WWW systems - the Global Data-Processing System (GDPS) and the Global Telecommunication System (GTS).

The space-based sub-system of the GOS comprises satellites of two types: NOAA polar-orbiting satellites and geostationary satellites, GOES. Both types of satellites provide qualitative information such as visible and infra-red cloud images over wide areas. Polar-orbiting satellites are equipped with vertical profile radiometers. By the use of somewhat complicated techniques, these instruments provide indications of the vertical temperature and humidity structure of the atmosphere, which may be input to numerical models for analysis and forecasting purposes. Geostationary satellites provide cloud imagery sufficiently frequently for some indications of wind structure to be inferred from the apparent movement of identifiable cloud systems. In this way, information about the two-dimensional wind field aloft may be obtained. This is of particular value near the Equator, where the quasi-geostrophic balance breaks down and winds cannot be inferred from pressure and temperature data, even where these are available. The two types of satellite also act as collection and relay stations for both raw and processed information.

One of the essential elements of the WWW is the Global Telecommunication System (GTS) which offers telecommunication facilities and arrangements for the rapid and reliable collection, exchange and distribution of observational data and processed information.

As part of the U.S. commitment to the World Weather Watch, NESDIS (OSDPD) has assumed the responsibility of generating and transmitting the following satellite data on the GTS on a routine basis:

1) Satellite Sea Surface Temperature (SST) Observations - transmitted twice daily

2) Satellite Wind Observations (Pix Pair Winds)

3) Satellite Derived Soundings

4) Satellite Tropical Disturbance Summaries and Tropical Storm Weather Bulletins - summaries are issued on a routine basis and bulletins are issued as required to affected countries based on analysis of satellite imagery in the tropical portions of the western Pacific and Indian Oceans.

5) Satellite Image Derived Wind Vectors - derived three times daily and relayed to 20 foreign countries. The wind vectors are obtained primarily over the tropical and subtropical oceanic areas within view of the GOES spacecraft.

In addition, OSDPD provides to the Agency for International Development (AID), as part of the U.S. WWW commitment, a daily summary for North Africa and the Caribbean Islands identifying areas of precipitation based on interpretation from satellite imagery. Also included is the latest information on the location, strength and movement of tropical weather systems. These summaries are based on imagery from GOES, NOAA, and METEOSAT (ESA) satellites, and are distributed by telecopier.

2. World Climate Programme (WCP)

The World Climate Programme was established in 1979 as one of the major programs of the WMO. Its basic objectives are: (a) to take advantage of man's present knowledge of climate; (b) to take steps to improve this knowledge significantly; and (c) to foresee and to prevent potential man-made changes in climate that might be adverse to the well-being of humanity.

- World Climate Research Programme (WCRP)

The basic objectives of the WCRP are to determine to what extent climate can be predicted and the extent of man's influence on climate. The WCRP component of the WCP is conducted jointly by WMO and ICSU.

- Working Group on Satellite Observing Systems for Climate Research

This group reviews requirements for satellite observations and measurements, and promotes multinational efforts for implementing observing systems needed by WCRP. (Harold Yates, ORA)

- International Satellite Cloud Climatology Project (ISCCP)

The objective of the International Satellite Cloud Climatology Project, a joint project of the WMO (WCRP)/IAMAP/ICSU (COSPAR), is to create a cloud climatology data set for the years 1983-87 using global coverage by six international polar-orbiting and geostationary meteorological satellites: GOES-East, GOES-West, NOAA-7 (U.S.A.), GMS (Japan), INSAT (India), and METEOSAT (ESA). The NESDIS National Climatic Data Center (NCDC) has been involved in the project's planning, and will serve as a Sector Processing Center for ISCCP. In this capacity NCDC will obtain Advanced Very High Resolution Radiometer (AVHRR) data from the NOAA series of operational polar-orbiting satellites, produce a reduced resolution global data set and statistical parameters, and send the information to the Global Processing Center for the ISCCP.

3. Executive Council (EC) Panel of Experts on Satellites

Dr. John McElroy, Assistant Administrator for NESDIS, was nominated by the WMO to be the U.S. representative to serve on the EC Panel of Experts on Satellites. The objectives of the Panel are:

(a) to advise on identifying oppportunities or problem areas presented by the development and application of satellite technology;

(b) to assist in the maintenance on a current basis of a record of the plans of Members for satellite development and operations;

(c) to advise on programme coordination among satellite system operators, especially with respect to fulfilling the requirements of the World Weather Watch, World Climate Programme and other WMO programmes; and

(d) to make recommendations on technical aspects of achieving a high level of assurance for the continuity and reliability of an operational satellite system based on international cooperation.

The EC Panel met at the WMO Headquarters in Geneva in October 1983, and the next meeting is to take place in 1987.

4. Commission for Climatology (CCl)

The Commission is responsible for matters relating to: the study of climate and its effects on human activities, compilation of general requirements for the World Climate Programme (WCP), development and improvement of statistical methods, studies of human effects on climate, and development of effective presentation to users of climatological information.

Margaret Courain, Deputy Assistant Administrator for Information Services, is a U.S. Member of the CCl.

- Working Group on Climate Data Management

This group, started in 1983, is preparing an implementation plan and carrying out studies to insure the success of the World Climate Data Program. (Kenneth Davidson, NCDC - Chairman)

- Working Group in Urban and Building Climatology

The objectives of the group are: to identify the local influences of buildings and urban areas on the environment and the interaction between buildings and the urban atmospheric environment; to study the need and design the requirements; to advise on the training and education requirements for meteorolgists and climatologists working in the field of building and urban climatology; and to identify the problems arising from urbanization and extreme pressures on land and other natural resources. (Frank Quinlan, NCDC - Rapporteur on Building Climatology)

- Monthly Climatic Data for the World

NCDC receives (via GTS or in manuscript form from contributing countries) and publishes monthly worldwide surface and upper air data as part of a U.S. commitment to the WMO. These data are the most readily available source of their kind, and are used extensively by planners and researchers. (Dr. Alan McNab, NCDC)

- Regional Association (RA) IV Regional Atlas

NCDC is working to produce a climatic atlas of Region IV (North and South America) with data supplied by Mexico, Canada, and the U.S.

- Rapporteur RA-IV on Climatological Time Series

The objective of the program is to arrange for the preparation of a series of climatological data for Region IV suitable for the detection of climatic change. (Thomas Karl, NCDC - Rapporteur)

- World Weather Records

This project involves the collection of monthly temperature, pressure, and precipitation data from WMO countries for the publication of six regional volumes titled World Weather Records for the last two decades. (Peter Steurer, NCDC)

5. Commission for Marine Meteorology (CMM)

- Working Group on Marine Climatology

NCDC processes, formats, and exchanges surface marine observations with seven foreign processing centers and 40 countries. NCDC provides input to "Periodic Weather Summaries" over oceans, processes data for the 30-year "World Climate Atlas", and has produced a ten-volume series of publications called "Marine Climatological Summaries" for 1961-1970. All these products require the validation and processing of a large number of surface marine weather observations obtained through merchant vessel observations, U.S. Navy networks, the GTS, and the NOAA Data Buoy Office. (Richard Cram, NCDC)

6. Commission for Atmospheric Sciences (CAS)

- CAS Group of Rapporteurs on Use of Satellite Data for Research

This group assists members to increase research into methods for deriving environmental parameters from satellite radiances and for increasing the overall use of remotely sensed data in the atmospheric sciences. (P. Krishma Rao, ORA - Chairman)

7. Background Air Pollution Monitoring Network (BAPMoN)

The aim of the WMO, through the BAPMoN program, is to determine current levels of atmospheric pollution and to identify long-term trends in the concentration of significant climatic changes. NCDC produces an annual publication containing data on turbidity, precipitation chemistry, carbon dioxide, and suspended particulate matter, reported from international stations in the network.

8. Global Ozone Research and Monitoring Project

In support of the WMO Ozone Project, NESDIS (OSDPD) provides the World Ozone Data Center, part of the Canadian Atmospheric Environmental Service (AES), with ozone data from the Stratospheric Backscattered Ultra-Violet (SBUV/2) instrument onboard the polar-orbiting NOAA satellites. AES will use the data to investigate the effects of anthropogenic influences on the stratospheric ozone layer.

B. Intergovernmental Oceanographic Commission (IOC)

The Intergovernmental Oceanographic Commission is the leading United Nations intergovernmental body in marine scientific affairs and related ocean services, training, education and mutual assistance. For nearly 25 years, the IOC has actively carried out cooperative programs in pursuit of its basic purpose: to promote the scientific investigation of the ocean through the concerted action of its Member States. The United States is a Member State of the IOC and voluntarily participates in various IOC programs. NESDIS participates in a number of IOC programs, which are outlined below.

International Oceanographic Data Exchange (IODE)

1. IOC Working Committee on International Oceanographic Data Exchange (WC/IODE)

The major objective of the IODE is to collect, process, archive, retrieve and exchange oceanographic data and information on a worldwide basis with the aim to render services to the scientific community, to the off-shore industry and to the governments of Member States. The Working Committee on IODE has the task of adopting practices to facilitate the exchange of oceanographic data and information internationally. The WC/IODE approach utilizes task teams, groups of experts, and discipline-oriented rapporteurs to deal with specialized problems affecting international oceanographic data and information exchange.

Accomplishments of the WC/IODE include: (1) standardizing forms for reporting and coding data, (2) promulgating the concept of Declared National Programs (DNPs) as national activities being carried out with the intention to exchange the resulting data, (3) assisting in development of national oceanographic data centers, (4) supporting and facilitating exchange of, and access and referral to, information resulting from international programs such as MEDI, ASFIS, etc., (5) adopting the automated General Format 3 (GF-3) for international exchange of marine scientific data, (6) providing the mechanism for creation of Responsible National Oceanographic Data Centers (RNODCs), and (7) issuing the Manual on International Oceanographic Data Exchange.

NESDIS participation in the WC/IODE consists of the following activities:

--- U.S. National Coordinator for International Oceanographic Data Exchange (IODE) - Edward Ridley, NODC

--- Vice Chairman, WC/IODE - Edward Ridley, NODC

- --- Chairman, Group of Experts on Responsible National Oceanographic Data Centers (RNODCs) - Kent Hughes, NODC
- --- Chairman, Task Team on Development of IODE Data Center Services - Robert Lockerman, NODC
- --- U.S. Member, Group of Experts on Marine Information Management - James Churgin, NODC
- --- U.S. Member, Task Team on Ocean Data Management for Climatic Studies - James Churgin, NODC
- --- U.S. Member, Task Team on Marine Biological Data - Mary Christman, NODC
- --- U.S. Member, Task Team on Measured Wave Data - Phillip Hadsell, NODC
- --- U.S. Member, Group of Experts on Format Development - Douglas Hamilton, NODC
- --- U.S. Member, Task Team on Declared National Program/National Oceanic Program (DNP/NOP) Announcements - Ronald Moffatt, NODC
- --- U.S. Member, Task Team on Marine Pollution Data Exchange - John Audet, NODC
- --- U.S. Member, Task Team on Training, Education, and Mutual Assistance in the Marine Sciences (TEMA) - Edward Ridley, NODC
- --- U.S. Member, Task Team on Data on Non-Living Resources in the Oceans - Michael Loughridge, NGDC
- --- U.S. Member, Task Team on Exchange/Archiving of Airborne and Satellite Remotely Sensed Oceanographic Data - Bruce Needham, NCDC
- --- U.S. Member, Task Team on Marine Information Management - Robert Freeman, AISC

2. Responsible National Oceanographic Data Centers (RNODCs)

NODC has also volunteered to act as Responsible NODC (RNODC) for the following programs:

a. Integrated Global Ocean Services System (IGOSS)

IGOSS is a worldwide service program whose purpose is to promote, develop, and coordinate the international machinery necessary to acquire, exchange, and disseminate ocean data. It is coordinated by the IOC and the World Meteorological Organization (WMO). NODC maintains a file of IGOSS data collect-ed worldwide, and makes the data available to secondary users in a standard format.

b. First GARP Global Experiment (FGGE) Operational Year (FOY)

This program provides data management services for the oceanographic data collected during the FGGE-FOY. Special services include the establishment of the Global Ocean Data Inventory (GODI) (a directory of all oceanographic data-gathering activities worldwide from September 1978 to March 1980), and the Global Ocean Climate Data Base (GOCDB), consisting of data collected during the FOY.

c. Marine Pollution Monitoring Program, Petroleum (MARPOLMON-P)

As RNODC, NODC's role is to acquire all exchangeable data collected under the MARPOLMON suitable for processing and archiving, and publishing an inventory of data. MARPOLMON-P is concerned with the monitoring of petroleum pollutants in oceans and on beaches, especially in the Gulf of Mexico and the Caribbean Sea.

d. IOC Association for the Caribbean Sea and Adjacent Regions (IOCARIBE)

IOCARIBE was established by the IOC Assembly in 1975 to continue and devel-op the regional cooperation in the marine sciences built over seven years under the Cooperative Investigation of the Caribbean and Adjacent Regions (CICAR). NODC acted as the Regional Data Center until 1980, when it became the RNODC for IOCARIBE. The program consists of assistance to IOC Member States from the IOCARIBE area (Gulf of Mexico, Caribbean Sea and adjacent area) with the processing of data collected in those areas.

. Fisheries Information System (ASFIS)

ASFIS is a joint program of the Food and Agriculture Organization (FAO) of the United Nations, the IOC, and the United Nations Ocean Economics and Technology Branch (UNOETB). ASFIS is an international system for the collection, storage and retrieval of bibliographic information relating to the science, technology, and management of marine and freshwater resources.

NESDIS (Robert Freeman, AISC) is a member of the Joint FAO/IOC/UN(OETB) Panel of Experts on ASFIS, which advises on the needs, plans, and development of international marine and freshwater science and technology information services.

A major product of ASFIS is the monthly abstract journal and computer-searchable data base, Aquatic Sciences and Fisheries Abstracts (ASFA). The Assessment and Information Services Center (AISC) of NESDIS makes the ASFA data base, which includes about 125,000 references, available throughout the United States. AISC (Robert Freeman) is also a member on the ASFA Advisory Board, which provides policy and technical guidance for international coverage of the published information on marine and freshwater science and technology.

4. The Tsunami Warning System (ITSU)

The International Coordination Group for the Tsunami Warning System in the Pacific provides input for the improvement of the system's warning capabilities and serves as the coordinating body for the international tsunami warning system, which provides tsunami information and warnings to Pacific communities to minimize the risks from these hazardous ocean waves. (James Lander, NGDC - Observer for the WDC-A).

[illegible]. International Council of Scientific Unions (ICSU)

The International Council of Scientific Unions (ICSU) is an international non-governmental scientific organization composed of 18 international Scientific Unions, 65 National Members, 17 Scientific Associates and 4 National Associates. Its principal objective is to encourage international scientific activity for the benefit of mankind by initiating, designing, and coordinating international scientific research projects.

NESDIS participates in a number of ICSU programs described below.

1. Panel on World Data Centers (Geophysical and Solar)

The ICSU Panel on World Data Centers (Geophysical and Solar) provides guidance for the operation of all World Data Centers (WDCs), described in Section V. The panel promotes international cooperation in data exchange, has established WDCs in the United States, USSR, and other countries, and prepares the Guide to International Data Exchange through the World Data Centers.

The ICSU Panel includes representatives of the WDCs and the international scientific bodies concerned. NESDIS Panel membership includes Alan Shapley, Secretary, (ORA), and Dr. Michael Chinnery (NGDC).

2. Committee on Data for Science and Technology (CODATA)

The goal of CODATA, as stated in its constitution, is to improve the quality, reliability and accessibility of data of importance to science and technology. The term "data" is interpreted to include not only quantitative information on the properties and behavior of matter, but other factual experimental and observational data as well. The central theme of CODATA is cooperation in both the interdisciplinary and international dimensions. It seeks to fulfill a role that is not easily handled by a discipline-based organization like a scientific union or by a national body.

The activities undertaken by CODATA may be grouped under the following headings: preparation of key data sets, guidelines to the presentation of data, supplying information on sources of reliable data, education and training, coordination of multinational projects, and conferences.

In the future, CODATA is expected to focus more strongly on the growing scale of computer-based data dissemination. The need for standardization of formats, terminology, and search software is already apparent in the pressure for more "user-friendly" on-line systems. Through its dual mission that cuts across both disciplinary and geographical boundaries, CODATA should have a key role to play.

Margaret Courain, Deputy Assistant Administrator for Information Services of NESDIS, is a member of the NOAA liaison with the U.S. National Committee for CODATA of the National Research Council Numerical Data Advisory Board.

- CODATA Geosciences Committee

The objectives of the committee are to develop CODATA activities in geosciences, coordinate with geoscience activities in ICSU Unions, promote quality control, standard compaction and disposal recommendations, and sponsor workshops, seminars, and consultations. (James Lander, NGDC - Member)

3. Committee on Space Research (COSPAR)

- Advisory Committee on Data Problems and Publications (ACDPP)

The ACDPP promotes the efficient exchange of space-related data collected by satellite or ground-based instruments and assists with the publication of data, information, and results. (Joseph Allen, NGDC - Member)

4. Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)

- Steering Committee for Monitoring the Sun-Earth Environment (MONSEE)

MONSEE objectives are to oversee the collection, archiving, cataloguing and distribution of data through the World Data Center system for magnetospheric physics, atmsopheric physics, and solar-interplanetary physics. (Joe Allen, NGDC - Member).

- Analysis Phase International Magnetospheric Study (IMS)

With supplementary NOAA and international support, NGDC headed the central information collection and dissemination office during the 1976-1979 data collection phase of the IMS. NGDC work has continued into the post-IMS analysis phase in maintenance of a special data base begun for IMS and supporting workshops and analyses. (Joseph Allen, NGDC)

- Middle Atmosphere Program (MAP) Steering Committee

The MAP Steering Committee guides a coordinated international program of data collection and analysis dealing with the chemistry and physical dynamics of the Middle Atmosphere (about 10 to 100 km altitude). (Joseph Allen, NGDC - Member representing WDC-A, Solar-Terrestrial Physics)

5. International Union of Geodesy and Geophysics (IUGG)

a. International Association of Geomagnetism and Aeronomy (IAGA)

- Working Group on Geophysical Indices

This Group coordinates international data collection and analysis for derivation of geophysical indices. (Joseph Allen,NGDC - Member)

- Working Group on Collection and Dissemination of Data

This Group coordinates the international collection and exchange of geomagnetic and aeronomical data, and will participate in updating the ICSU Guide to International Exchange through the World Data Centers. (Joseph Allen, NGDC - Chairman)

b. Inter-Union Commission on the Lithosphere (ICL)

Dr. Michael Chinnery, NGDC, is the chairman of the ICL's Coordinating Committee on Data Centers and Data Exchanges, which coordinates the data management activities of the International Lithosphere Project (ILP). ILP is a joint project of the IUGG and the International Union of Geological Sciences (IUGS) to look at problems related to the origin and development of the earth's crust.

c. Historical Seismic Data Project

The World Center Center-A for Solid Earth Geophysics and other elements of NGDC are engaged in a project to microfilm historically important seismograms worldwide. Other project participants include ICSU's International Association of Seismology and Physics of the Earth's Interior (IASPEI) of the IUGG, UNESCO, U.S. Geological Survey, and the Pan American Institute of Geography and History (PAIGH), which is funding the filming of South American records. The WDC-A will soon be sending cameras and supplies to Egypt's Helwan Institute of Astronomy and to the USSR's Institute of Physics of the Earth for filming of seismic records, and the film will then be archived at WDC-A. Records from the Manila Observatory in the Philippines will be filmed by WDC-A in the U.S..

d. Federation on Astronomical and Geophysical Services (FAGS)

- Permanent Service on the Fluctuation of Glaciers (PSFG)

The World Data Center-A for Glaciology collects glacier fluctuation data and exchanges the data with PSFG. Data are received from twenty-three countries concentrated in the areas of the Arctic, western North America, Scandinavia, the Alps, and mountain ranges of the USSR.

- International Gravity Bureau

The World Data Center-A for Solid Earth Geophysics exchanges gravity data through the International Gravity Bureau, which operates under the authority of the IUGG.

6. International Union of Geological Sciences (IUGS)

- Commission on Storage, Automatic Processing and Retrieval of Geological Data (COGEODATA)

COGEODATA acts as a coordinating body of geological science data matters. (James Lander, NGDC - Member)

7. International Union of Radio Science (URSI)

- URSI Working Group G1: International Network Advisory Group (INAG)

INAG oversees the operation of the international network of analog ionosondes and the collection, archiving, and dissemination of their data output via the World Data Center system. (Raymond Conkright, NGDC - Secretary)

- URSI Working Group G4: Task Group on International Reference Ionosphere (IRI)

The task group publishes, updates and disseminates the International Reference Ionosphere. (Raymond Conkright, NGDC - Member)

8. International Astronomical Union (IAU)

- International Ursigramme and World Days Services (IUWDS)

The IUWDS's task is the international coordination of intermittent solar-terrestrial physics observations and the provision of forecasts and solar activity alerts through international communications networks. (Helen Coffey, NGDC - Secretary)

9. Global Atmospheric Research Programme (GARP)

GARP was jointly developed in 1967 by ICSU and the WMO. It is a program for studying those physical processes of the atmosphere that are essential for the understanding of: 1) the transient behavior of the atmosphere as manifested in the large-scale fluctuations which control changes in the weather, and 2) the factors that determine the statistical properties of the general circulation of the atmosphere. The World Data Center-A for Meteorology (NGDC) is the primary archive for GARP experiments, storing climatological meteorological data and information, and also conducts international exchange of this information.

D. United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)

NOAA/NESDIS attends meetings of COPUOS and its subcommittees to advise the Head of the U.S. Delegation on policies and positions relating to the U.S. civil remote sensing satellite program. NOAA/NESDIS is responsible for drafting and coordinating U.S. position papers on remote sensing. NOAA/NESDIS experts on the U.S. Delegation also interact with foreign agency counterparts during COPUOS to exchange scientific and technical information on respective remote sensing programs.

V. DATA AND INFORMATION COLLECTION AND EXCHANGE ACTIVITIES

A. The World Data Center System

The World Data Center system was established in 1957 to collect data from the numerous and widespread observational programs of the International Geophysical Year (IGY) and to make such data readily accessible to interested scientists and scholars. The International Council of Scientific Unions (ICSU) Panel on World Data Centers is responsible for the operation of all WDCs.

The WDC system consists of World Data Center A (WDC-A) located in the United States; WDC-B located in the U.S.S.R; and several WDC-Cs located in Western Europe, Australia, and Japan. WDC-A is established under the auspices of the U.S. National Academy of Sciences, where the Coordination Office is located. WDC-A is divided into eight discipline subcenters, six of which are operated by NESDIS. The National Climatic Data Center (NCDC) in Asheville, North Carolina, operates the WDC-A for Meteorology. The National Oceanographic Data Center (NODC) in Washington, D.C., operates the WDC-A for Oceanography. The National Geophysical Data Center (NGDC) in Boulder, Colorado, operates the WDC-As for Solar-Terrestrial Physics, Solid-Earth Geophysics, Marine Geology and Geophysics, and Glaciology (Snow and Ice). The WDC-A for Glaciology is actually handled under a contract with the University of Colorado's Cooperative Institute for Research in Environmental Sciences, in Boulder.

The main task of the WDC-As is to exchange data in accordance with ICSU published guidelines. Each of the data centers provides data to other World Data Centers and to foreign scientists. Being coordinated by ICSU, the WDC system is a scientist-to-scientist arrangement, and involves no inter-governmental agreements. The following pages list the major foreign agencies and institutions with which the NESDIS WDC-As exchange data or from which data are acquired.

1. Bilateral Data Exchanges of WDC-A, Oceanography

Country	Coordinating Institution
Argentina	Servico de Hidrografia Naval, Centro Argentino de Datos Oceanograficos
Australia	Hydrographic Office, R.A.N., Australian Oceanographic Data Centre
Belgium	Ministry for Science Policy, Institute of Marine Scientific Research
Brazil	Diretoria de Hidrografia e Navegacao, Banco Nacional de Dados Oceanograficos
Canada	Marine Sciences and Information Directorate, Marine Environmental Data Service
Chile	Instituto Hidrografico de la Armada, Centro Nacional de Datos Oceanograficos de Chile
Colombia	Armada Nacional, Centro Colombiano de Datos Oceanograficos
Cuba	Academia de Ciencias de Cuba, Instituto de Oceanologia
Denmark	The Royal Danish Hydrographic Office
Egypt	Institute of Oceanography and Fisheries, Egyptian National Oceanographic Data Center
Federal Republic of Germany	Deutsches Ozeanographisches Datenzentrum
Finland	Institute of Marine Research
France	Centre National pour l'Exploitation des Oceans
German Democratic Republic	Academy of Sciences of the GDR, Institute of Marine Research
Ghana	Fishery Research Unit[1]
Iceland	Oceanographic Department, Marine Research Institute[2]
India	National Institute of Oceanography, India National Oceanographic Data Centre
Indonesia	National Institute of Oceanology, Institute of Marine Research

Country	Coordinating Institution
Ireland	Department of Fisheries and Forestry, Fisheries Research Center
Israel	Israel Maritime League, Israel Ocenoagraphic and Limnological Research, Ltd.
Italy	Consiglio Nazionale delle Richerche, Centro Nazionale per la Raccolta di Dati Oceanografici
Ivory Coast	Ministere de la Recherche Scientifique, Centre de Recherches Oceanographiques, Abidjan
Japan	Hydrographic Department, Maritime Safety Agency, Japan Oceanographic Data Center
Korea	Korea Ocean Research and Development Institute, Korean Oceanographic Data Center
Madagascar	Ministere de l'Enseignement Superieur et de la Recherche Scientifique, Centre National de Recherche Oceanographiques
Mauritania	Ministere de Peches et de l'Economie Maritime, Center National de Recherches Oceanographiques et des Peches
Mexico	Secretaria de Marina, Centro de Datos Oceanograficos
Netherlands	Royal Netherlands Meteorological Institute, Netherlands Centre for Oceanographic Data
Norway	Fiskeridirektoratets Havforskningsinstitutt, Norsk Oseanografisk Datasentir
Pakistan	University of Karachi, Department of Zoology
Peru	Instituto del Mer del Peru, Oceanographic Department
Poland	Polska Akademia Nauk, Zaklad Oceanologii Instytutu Geofizyski[2]
Portugal	Instituto Hidrografico, Centro de Documentacao e Informacao

Country	Coordinating Institution
Romania	Institutul Roman de Certetari Marine[3]
Senegal	Institut Senegalais de Recherches Agricoles, Centre de Recherche Oceanographiques de Dakar-Thiaroye
South Africa	National Research Institute for Oceanology, South African Data Centre for Oceanography
Spain	Instituto Espanol de Oceanografia, Centro Espanol de Datos Oceanograficos
Sweden	National Board of Fisheries, Institute of Hydrographic Research
Taiwan	National Taiwan University, Institute of Oceanography
Thailand	Chulalongkorn University, Marine Sciences Department
United Kingdom	Institute of Oceanographic Sciences, Marine Information and Advisory Service
U.S.S.R.	World Data Center B, Oceanography
Yugoslavia	Institute of Oceanography and Fisheries, Split

1 With assistance from FAO/United Nations Development Programme (UNDP).

2 With exchange of marine data and data inventory forms takes place through the International Council for the Exploration of the Seas (ICES), Denmark.

3 Data exchanged through World Data Center B, Oceanography, in USSR.

2. Bilateral Information Exchanges of WDC-A for Glaciology (Snow and Ice)

Country	Coordinating Institution
Argentina	Instituto Antartico Argentino, Direccion Nacional del Antartico
Australia	Department of Science and Technology, ANARE
Austria	Bundesminsterium fur Land-und Forstwirtschaft
	Osterreichisches Kuratorium fur Alpine Sicherheit
Canada	Alberta Environment Water Resources Management Services, Technical Services Division
	Arctic Institute of North America
	Atmospheric Environment Service
	British Columbia Ministry of Environment, Water Investigation Branch
	Canada Centre for Remote Sensing
	National Hydrology Research Institute
	Memorial University of Newfoundland, Centre for Cold Ocean Resources Engineering
	St. Lawrence Seaway Authority
Chile	Club Andino de Chile
	Comite Nacional de Investigaciones Antarcticas, Instituto Antartico Chileno
	Instituto Anartico Chileno
Czechoslovakia	Slovak Academy of Sciences, Institute of Hydrology and Hydraulics

Country	Coordinating Institution
Denmark	Commission for Scientific Research in Greenland
	Danske Meteorologiske Institut (Arboger)
	Expedition Glaciologique International au Groenland
	Kommissionen for Vidnskabelige Undersogelser i Gronland
	Royal Danish Geographical Society
	State Icebreaker Service
	Statens Isjeneste
Federal Republic of Germany	Alfred-Wegener Institut fur Polarforschung
	Deutsche Gesellschaft fur Polarforschung
	Hydrological Institute
Finland	Institute of Marine Research
	National Board of Waters
France	Academie des Sciences, Comite National Francais des Recherches Antarctiques
	Association Nationale pour l'Etude de la Neige et des Avalanches
	Centre National de la Recherche, Laboratoire de Glaciologie
	Service de la Production Hydraulique

Country	Coordinating Institution
Italy	Comitato Glaciologico Italiano
	Istituto Geografico Polare
Japan	Institute of Low Temperature Sciences
	Japan Meteorological Agency
	Japan Polar Research Association
	Japan Weather Association
	Japanese Society of Snow and Ice
	Maritime Safety Agency
	National Institute of Polar Research
	National Research Center for Disaster Prevention
Mexico	Association de Ingenieros d Minas, Metalurgistas y Geologog de Mexico
Monaco	Comite Arctique International
Netherlands	Directorie Waterhuishouding en Waterbeweging
New Zealand	National Committee on Antarctic Research
	New Zealand Department of Scientific and Industrial Research, Antarctic Division
Norway	Det Norske Meteorologiske Institutt
	Norges Vassdrags-og Elektrisitetsvesen
	Norsk Polarinstitutt
	Norwegian Academy of Science and Letters, Norwegian National Committee on Polar Research

Country	Coordinating Institution
People's Republic of China	Lanzhou Institute of Glaciology and Cryopedology
Poland	University of Wroclaw
South Africa	Council for Scientific and Industrial Research, South African National Committee on Polar Research
Sweden	Sveriges Meteorologiska och Hydrologiska Institut
Switzerland	Eidgenossischen Technische Hochschule
United Kingdom	British Antarctic Survey
	Great Britain Meteorological Office
	International Glaciological Society
	National Meteorological Library
	The Royal Society, British National Committee on Antarctic Research
	Scott Polar Research Institute
	University of East Anglia, Climate Research Unit
	World Data Center-C
U.S.S.R.	Akademiia Nauk SSSR, Institut Geografii
	All-Union Research Institute of Hydrometeorological Information, WDC-B
	Arkticheskii i Antarkticheskii Naunchno-Issledovatel'skii Institut
	Sredneaziatskii Regional'nyi Naunchno-Issledovatel'skii Institut

3. Foreign Sources of Data for WDC-A for Solar-Terrestrial Physics (STP)

Country	Coordinating Institution
Algeria	Centre National Astronomie, Astrophysique et Geophysique
Angola	Instituto Nacional e Hidrometeorologia e Geofisica
Argentina	Instituto Antartico Argentino
	Servicio Meteorologico Nacional
	Universidad Nacional de la Plata
	Universidad Nacional de Tucuman
Australia	Bureau of Mineral Resources, Geology, and Geophysics
	CSIRO Culgoora Solar Observatory
	Ionospheric Prediction Service
	University of Sydney
Austria	Zentralanstalt fur Meteorologie und Geodynamic
Bangladesh	Bangladesh Meteorological Department
Belgium	Institut Royal Meteorologique
	Universite de Liege
Bolivia	Universidad Mayor de San Anders

Country	Coordinating Institution
Brazil	Conselho Nacional de Desenvolvimento Cientifico e Technologico Observatorio Nacional
	Instituto de Pesquisas Espaciais
Bulgaria	Bulgarian Academy of Sciences
Canada	Department of Communications
	Energy, Mines and Research
	Herzberg Institute of Astrophysics
Chile	Universidad de Concepcion
Colombia	Instituto Geografico "Agustin Codazzi"
	Universidad de Canca
Costa Rica	Instituto Costarricense de Electricidad
Cuba	Instituto de Geofisica y Astronomia
Czechoslovakia	Ceskoslovensa Akademie Ved
	Slovak Academy of Sciences
Denmark	Danish Meteorological Institute
	Technical University of Denmark
Egypt	Helwan Institute of Astronomy and Geophysics

Country	Coordinating Institution
Ethiopia	Addis Ababa University
Federal Republic of Germany	Aussenstelle Astronomie Institut de Universitat Tubingen
	Deutsches Hydrographisches Institut
	Forschungsinstitat der Deutschen Bundespost
	Geophyikalische Observatorium
	Heinrich-Hertz Institute
	Institut fur Geophysik
	Institut fur Reine und Angewandte Kernphysik
	Ionospharen Institute
	Max-Planck Institute fur Aeronomie
Finland	Finnish Meteorological Institute
	University of Helsinki
France	Observatoire de Meudon
	Observatoire de Paris
	Universite de Paris
	Universite de Louis-Pasteur
German Democratic Republic	Zentralinstitut fur Physik der Erde der Adw der DDR

Country	Coordinating Institution
Greece	National Institute of Geology and Mining Research
	Ionospheric Institute, National Observatory of Athens
Hong Kong	Hong Kong University
Hungary	Central Institute of Meteorology
	Geofizikai Intezet
	Geofizikai Obszervatorium
Iceland	University of Iceland
India	Indian Institute of Geomagnetism
	National Geophysical Research Institute
	National Physical Laboratory of India
	Survey of India
Indonesia	Meteorological and Geophysical Institute
Iran	Tehran University
Ireland	Department of Transport and Power, Meteorological Service
Israel	Ministry of Labour
Italy	Citta Universitaria
	Instituto Nazaionale di Geofisica
	Universita di Genova

Country	Coordinating Institution
Japan	Geographical Survey Institute
	Institute of Physical and Chemical Research
	Kakioka Magnetic Observatory
	Maritime Safety Agency
	Nagoya University
	National Institute for Polar Research
Kenya	University of Nairobi
Korea	Ministry of Communications
Madagascar	Observatoire de Tananarive
Mexico	Ciudad Universitarie
	Torre Central de Telecommunicacions
Mongolia	MPR Academy of Sciences
Morocco	Institut Scientifique
Mozambique	Servico Meteorologico de Mocambique
Netherlands	Royal Netherlands Meteorological Institute
New Zealand	Geophysical Observatory
Nigeria	University of Ibadan

Country	Coordinating Institution
Norway	The Auroral Observatory Norwegian Defense Research Establishment University of Bergen
Pakistan	Geophysical Centre
People's Republic of China	State Seismological Bureau
Peru	Instituto Geofisico del Peru Universidad Nacional de San Agustin de Areguipa
Philippines	Bureau of Coast and Geodetic Survey Manila Observatory
Poland	Institute of Telecommunications Polska Akademia Nauk
Portugal	Instituto Nacional de Meteorologia e Geofisica Universidade de Coimbra
Romania	Observatorul Geofizic Surlari
Senegal	Centre ORSTOM
South Africa	Magnetic Observatory of the CSIR National Institute for Telecommunications Research Rhodes University

Country	Coordinating Institution
Spain	Instituto Geografico Nacional
	Instituto y Observatorio de Marina
	Observatorio del Ebro
Sweden	Geological Survey of Sweden
	Kiruna Geophysical Institute
	Research Institute of National Defence
Switzerland	Institute of Applied Physics
	Institute of Astronomy ETH-Zentrum
	Observatoire Cantonal
Taiwan	National Taiwan University
	Telecommunication Laboratory
Thailand	Scientific Research Corporation of Thailand
Turkey	Istanbul-Kandilli Observatory
United Kingdom	British Antarctic Survey
	British Geological Survey
	World Data Center C1, Appleton Laboratory
U.S.S.R.	IZMIRAN, Geomagnetism Section
Vietnam	CNRS du Vietnam, Institut des Sciences de la Terre

Country	Coordinating Institution
Western Somoa	Apia Observatory
Yugoslavia	Geomagnetiska Observatory
	Institute "Mihailo Pupin"
Zaire	Department des Transcom, La Meteorologie Illeme Division
	Direction de la Meteorologie

4. Bilateral Data Exchanges of WDC-A, Solid-Earth Geophysics

WDC-A for Solid-Earth Geophysics exchanges data with over 300 institutions around the world and receives data from more than 5,000 foreign institutions. The following is a representative list of the data exchanges:

Country	Coordinating Institution
Algeria	Centre National Astronomie, Astrophysique et Geophysique
Angola	Instituto Nacional de Hidrometeorologia e Geofisica
Argentina	LPA - Observatorio Astronomico Servicio de Hidrografia Naval Universidad Nacional de la Plata
Australia	Bureau of Mineral Resources University of Queensland
Austria	Erdmagnetisches Observatorium, Zentralanstalt fur Meteorlogie und Geodynamic
Bangladesh	Geophysical Observatory
Belgium	Observatoire Royal
Belize	Ministry of Natural Resources
Benin	University of Benin
Bermuda	Seismograph Station, Fort George Hill

Country	Coordinating Institution
Bolivia	Observatorio San Calixto
Botswana	Botswana Geological Survey
Brazil	Dept. Nacional de Producao Mineral Observatorio Magnetico de Vassouras
Brunei	Government Geologist
Burma	Burma Surveys Department
Burundi	Dept. de Geologie et Mines du Burundi
Cambodia	Ministry of Industry, Mines and Minerals Prospecting
Cameroon	ORSTOM
Canada	Department of Energy, Mines and Resources University of Toronto Victoria Magnetic Observatory
Cape Verde	Servicio Meteorologico de Cabo Verde
Central African Republic	Centre de Bangui, ORSTOM
Chad	Direction des Mines et de la Geologie

Country	Coordinating Institution
Chile	Instituto Hidrografico de la Armada University of Chile
Colombia	Universidad Javeriana
Congo	Direction des Mines et de l'Energie
Costa Rica	Instituto Geografico de Costa Rica
Cuba	Instituto de Geofisica y Astronomia
Cyprus	Department of Lands and Surveys
Czechoslovakia	Institute of Geophysics
Denmark	Danish Meteorological Institute
Djibouti	ISRES
Dominican Republic	Instituto Geografico Universitario
Ecuador	Observatorio Astronomica de Quito
Egypt	Hewlan Institute of Astronomy and Geophysics
El Salvador	Instituto Geografico Nacional
Ethiopia	Addis Ababa University

Country	Coordinating Institution
Federal Republic of Germany	Deutches Hydrograph Institut
Fiji	Mineral Resources Department
France	Centre Oceanologique de Bretagne Observatoire de Chambon-La-Foret
Gabon	Bureau de Recherches Geologique et Minieres
Gambia	Survey Department
German Democratic Republic	Deutsches Hydrograph Institut Zentralinst fur Physik der Erd Adw der DDR
Ghana	University of Science and Technology
Greece	National Observatory of Athens
Greenland	Geofysisk Observatorium
Guatemala	Instituto Geografico Nacional
Guinea	Institute Polytechnique de Conakry
Guinea-Bissau	Servicos de Geologia e Minas
Guyana	Surveys, Lands, and Mines Dept.

Country	Coordinating Institution
Haiti	Service de Geodesie et de Cartographie
Hondorus	Instituto Geografico Nacional
Hong Kong	Royal Observatory
Hungary	Geofizikai Obszervatorium
Iceland	University of Iceland
India	India Meteorological Department
	Indian Institute of Geomagnetism
	Survey of India
Indonesia	Department of Geology and Geophysics
Iran	Tehran University
Iraq	Department of Scientific and Industrial Research
Ireland	Valentia Observatory
Israel	Weizmann Institute of Science
Italy	Cattedra Fisica Terrestre
	Universita di Bari
Ivory Coast	Recherches Minieres Societe de Devel. Mtn.

Country	Coordinating Institution
Jamaica	University of the West Indies
Japan	Geographical Survey Institute National Institute of Polar Research Shiraki Microearthquake Observatory
Jordon	Natural Resources Authority
Kenya	University of Nairobi
Korea	Central Meteorological Office
Kuwait	Kuwait University
Laos	Service de Geologie
Lesotho	Dept. of Mines and Geology
Liberia	Liberian Cartographic Services
Libya	University of Al-Fateh
Luxembourg	Administration du Cadastre et de la Topographie
Magadascar	Observatoire de Tananarive
Malawi	Geological Survey of Malawi
Malaysia	University of Science of Malaysia

Country	Coordinating Institution
Mali	Institut National de Topographie
Malta	University of Malta
Mauritania	Directeur National des Mines et de la Geologie
Mauritius	Plaisance Magnetic Observatory
Mexico	Cuidad Universitaria
Mongolia	Geomagnetic Research Laboratory
Morocco	Service de Physique du Globe
Mozambique	Servico Meteorologico de Mocambique
Nambia	Geological Survey
Nepal	Ministry of Land Reform
Netherlands	Royal Netherlands Meteorological Institute
New Zealand	Geophysical Observatory Seismological Observatory
Nicaragua	Nicaragua de Estudios Territoriales
Niger	Bureau de Recheres Geologiques et Minieres
Nigeria	The Magnetic Observatory

Country	Coordinating Institution
North Korea	Geology and Geography Research Institute
Norway	University of Oslo
Oman	Oman Technical Institute
Pakistan	Directorate of Geodesy
Panama	Institute Geografico Nacional
Papua New Guinea	Central Volcanological Observatory
Paraguay	Direccion de Recursos Minerales
People's Republic of China	National Bureau of Oceanography
	State Seismological Bureau
Peru	Instituto Geofisico del Peru
Philippines	Bureau of Coast and Geodetic Survey
Poland	Centralne Observatorium Geofizyczne Pan
Portugal	Universidad de Coimbra
Romania	Observatorul Geofizic Surlari
Rwanda	Institut National de Recherche Scientifique

Country	Coordinating Institution
Saudi Arabia	Ministry of Petroleum and Mineral Resources
Scotland	Eskdalemuir Geophysical Observatory
Senegal	Centre ORSTOM
Seychelles	Ministry of Planning and Development
Sierra Leone	Fourah Bay College
Solomon Islands	Geological Survey
Somalia	Ministry of Public Works
South Africa	Magnetic Observatory of the CSIR
South Korea	Central Meteorological Survey
Spain	Instituto y Observatorio de Marina
	Universidad Complutense
Sri Lanka	Geological Survey Dept.
Sudan	University of Khartoum
Swaziland	Geological Survey and Mines Dept.
Sweden	University of Uppsala

Country	Coordinating Institution
Switzerland	Observatoire Cantonal
Syria	Ministry of Petroleum
Tahiti	Centre ORSTOM de Papeete
Taiwan	Central Weather Bureau
Tanzania	Ministry of Commerce and Industry
Thailand	Royal Thai Survey Dept.
Togo	University of Benin
Trinidad and Tobago	Land and Surveys Dept.
Tunisia	Service Geologique de Tunisie
Turkey	Institute of Physics of the Earth
Uganda	University College of East Africa
U.S.S.R.	Academy of Sciences of U.S.S.R. Institute of Earth Physics
United Arab Emirates	Centre for Documentation and Research
United Kingdom	British Geological Survey
Upper Volta	Directeur de la Geologie et des Mines

Country	Coordinating Institution
Uruguay	Instituto Geografico Militar
Venezuela	Universidad Simon Bolivar
Vietnam	Laboratoire de Physique du Globe
Western Samoa	Apia Observatory
Yemen	Ministry of Public Works
Yugoslavia	Geomagnetska Observatory
Zaire	Centre Geophysique de la Karavia
Zambia	Dept. of Geological Survey
Zimbabwe	University of Zimbabwe

5. Bilateral Data Exchanges of WDC-A, Marine Geology and Geophysics

Country	Coordinating Institution
Canada	Bedford Institute of Oceanography Department of Energy, Mines and Resources Geological Survey Hydrographic Survey
Federal Republic of Germany	German Oceanographic Data Center
France	Bureau National des Donnees Oceaniques
Israel	Geological Survey
Japan	Geological Survey of Japan Japanese Oceanographic Data Center
New Zealand	New Zealand Oceanographic Institute
People's Republic of China	National Bureau of Oceanography
South Africa	University of Capetown
United Kingdom	Marine Information and Advisory Service
U.S.S.R.	World Data Center-B

B. NODC Bilateral Data Exchanges

The National Oceanographic Data Center (NODC) of NOAA/NESDIS acquires, processes, archives, analyzes, and disseminates global oceanographic data; develops analytical and descriptive products to meet user requirements, and provides facilities for the World Data Center-A, Oceanography. It was the first NODC established and houses the world's largest usable collection of marine data.

From its inception, NODC has conducted bilateral exchanges with foreign countries. The types of marine data that are exchanged include: ocean station and inshore data, surface and near surface observations, sea surface temperatures (SST), current data, mechanical and expendable bathythermographs, salinity/temperature/depth measurements, and biological data. The following is a list of foreign agencies and institutions that exchange data with NODC:

Country	Coordinating Institution
Argentina	Armada Argentina, Servicio de Hidrografia Naval, Centro Argentino de Datos Oceanograficos
Australia	Hydrographic Office, R.A.N., Australian Oceanographic Data Centre
Brazil	Diretoria de Hydrografia e Navegacao, Banco Nacional de Datos Oceanograficos
Canada	Marine Sciences and Information Directorate, Marine Environmental Data Service
Chile	Instituto Hidrografico de la Armada de Chile, Centro Nacional de Datos Oceanograficos
Colombia	Ministerio de Defensa Nacional, Centro Colombiano de Datos Oceanograficos
Ecuador	Instituto Oceanografico de la Armada, Centro Nacional de Datos Oceanograficos
Federal Republic of Germany	Deutsches Ozeanographisches Datenzentrum
Finland	Marine Science Department, Institute of Marine Research
France	Centre National pour l'Exploitation des Oceans, Bureau National des Donnees Oceaniques

Country	Coordinating Institution
Indonesia	National Institute of Oceanology
Japan	Hydrographic Department, Maritime Safety Agency, Japan Oceanographic Data Center
Mexico	Secretaria de Marina, Departamento de Ciencias Marinas, Centro de Datos Oceanograficos
New Zealand	Defence Scientific Establishment
People's Republic of China	Institute of Marine Science and Technological Information, National Bureau of Oceanography[1]
Peru	Instituto del Mar del Peru
South Africa	National Research Institute for Oceanography, South African Data Centre for Oceanography
Spain	Instituto Espanol de Oceanografia, Centro Espanol de Datos Oceanograficos
Thailand	Fisheries Department, Exploratory Fishing Unit
United Kingdom	Institute of Oceanographic Sciences, Marine Information and Advisory Service
USSR	All-Union Scientific Research Institute of Hydrometeorological Information, Oceanographic Data Centre of the USSR[2]

1 Program also includes assistance in establishing a National Oceanographic Data Center (PRC-NODC)

2 No active data exchange exists at present between NODC and the Soviet Data Center. U.S. and Soviet data are exchanged through World Data Centers A (U.S.) and B (USSR), Oceanography.

C. Experimental Equatorial Pacific Charts

NESDIS (OSDPD) produces experimental sea surface temperature (SST) contour charts of the Equatorial Pacific area to support studies by the Office of Research and Applications of the El Nino phenomenon and equatorial long waves. OSDPD also provides those charts to the following five agencies in Peru, Equador, and New Caledonia:

Country	Agency	Program
Equador	Centro de Levantamientas Intergrados de Recursos Naturales por Sensores Remotos (CLIRSEN)	Ocean monitoring to assist in fisheries development and prediction of El Nino
	Instituto National de Pesca	Support of Equador fishing industry
	Instituto Oceanographico de la Armada	Ocean monitoring
Peru	Servicio Nacional de Meteorologia e Hidrologia	Study of El Nino phenomenon and its impact on commercial fishing and the environment
New Caledonia	Office de la Recherche Scientifique et Technique Outre-Mer	Support of tropical tuna fishing industry

VI. OTHER COOPERATIVE PROGRAMS

A. Protocol on Cooperation with the People's Republic of China in Atmospheric Science and Technology

NOAA is the U.S. lead agency for a U.S./P.R.C. Protocol on Cooperation in Atmospheric Science and Technology, signed in 1979. The activities under this protocol bring together meteorologists of both countries in collaborative research and exchanges, providing the United States with access to climatic data and institutions. The cooperation will give U.S. scientists access for research in such areas as the North China Plain and the Tibetan Plateau, and the opportunity to study jointly with the Chinese such subjects as monsoons and mountain meteorology.

As part of the Training and Participation Program of the Protocol, NESDIS receives meteorologists from the State Meteorological Administration of the P.R.C. for 1 year of training followed by application of their training in such areas as meteorological satellite data processing, development of operational agroclimatic impact assessment for the P.R.C., quality control of meteorological data, and archiving of meteorological records.

NESDIS (AISC) also is involved with the North China Plain and North American Great Plains Comparative Study conducted by the National Science Foundation. The research project involves the comparison of climates and agriculture in the two plain regions with the objective of increasing and stabilizing the production of food and fiber through the application of climatic and agrometeorological science.

B. Protocol on Cooperation with the People's Republic of China in the Field of Marine and Fishery Science and Technology

NOAA is the U.S. lead agency for the U.S./P.R.C. Protocol on Cooperation in the Field of Marine and Fishery Science and Technology, signed in 1979. This program involves the exchange of knowledge gained by both U.S. and Chinese scientists in the field of marine science, the sharing of oceanographic data held in both countries, the exploration of cooperative activities in marine science, and the enhancement of understanding between U.S. and Chinese scientists.

The major NESDIS involvement is the exchange of oceanographic data, and the development of an oceanographic data center. NESDIS' National Oceanographic Data Center (NODC) has the lead in this activity, and has provided training to Chinese data specialists, and provided background information. Chinese scientists have provided oceanographic data to NODC and have received NODC data in their areas of interest.

C. United States/Japan Cooperative Program in Natural Resources (UJNR)

One outcome of President Johnson's visit to Japan in 1964 is a bilateral agreement between the United States and Japan in the area of natural resources, named the U.S./Japan Cooperative Program in Natural Resources (UJNR). The UJNR is composed of seventeen panels. NOAA and the Department of Agriculture are the principal operational agencies involved in the panels. Dr. Michael Loughridge, NGDC, is a member of the UJNR Sea Bottom Surveys Panel, which is involved with the exchange of technology, data, and information of mutual interest regarding ongoing programs. James Lander, NGDC, Dr. Celso Barrientos, AISC, and Dr. Michael Changery, NCDC, are members of the Panel on Wind and Seismic Effects, which, through cooperation and exchange of information, attempts to decrease the damage resulting from extreme winds, earthquakes, and tsunamis. Dr. Barrientos is also the U.S. Chairman of the Task Committee on Storm Surge and Tsunami, for this panel.

D. India Monsoon Research Program

As part of a bilateral Indo-U.S. Science and Technology Initiative headed by the National Science Foundation in the U.S., NOAA participates in two projects. The Numerical Weather Prediction of Monsoons Project's objective is to develop improved methods for prediction of the time, extent, and intensity of the monsoon. The Long-term Monsoon Variability Project is to develop improved understanding of the causes of the long-term fluctuations of the monsoon and the relationship to the fluctuations of the global atmospheric and oceanic circulation as a basis for long-range monsoon prediction.

E. Global Climatic Impact Assessment Technology for Drought/Disaster Early Warning and Technical Assistance

The NESDIS Assessment and Information Services Center (AISC) has been working with the Agency for International Development's Office of Foreign Disaster Assistance (OFDA) to improve national food security aid and drought/disaster management programs in the developing world by transferring and implementing operational climatic assessment programs in South and Southeast Asia, Latin America, the Caribbean Basin, and Africa. Working in cooperation with the Food and Agricultural Organization and WMO, AISC has successfully demonstrated and verified a reliable, timely, yet inexpensive global climate impact assessment technology. With this technique, assessments can alert decision-makers of potential drought/food shortage conditions by 30 days before crop harvesting begins. This usually represents a three-six month early warning lead-time before food shortages occur.

VII. TRAINING

In 1983, NESDIS provided long-term training opportunities at its facilities to 13 trainees from Argentina, Burma, Egypt, Taiwan, and the People's Republic of China. Training specialties included application and interpretation of meteorological satellite data, sea surface temperature data, meteorological satellite data processing operations, crop modeling, solar radiation studies, statistics of climate data, management of marine geological and geophysical data, agroclimatic impact assessments, and quality control of meteorological data. In addition, NESDIS experts participated in at six international workshops, training sessions, and roving seminars in cooperation with the World Meteorological Organization concerning operational uses of meteorological satellite data, hydrological forecasting, interpretation of satellite data for tropical cyclone analyses, and very-short range forecasting. As a result of this participation, training was provided to over 130 participants from forty countries.

Training for nine foreign nationals from El Salvador, Ethiopia, Nepal, and the People's Republic of China is now in progress in such fields as meteorological satellite data processing, agrometeorology, and seismology data management. NESDIS is in the process of reviewing additional training requests from Brazil, Egypt, India, Kuwait, and Pakistan.

One ongoing training program that will be expanded this year is part of the NOAA/AID project called Global Climatic Impact Assessment Technology for Drought/Disaster Early Warning and Technical Assistance. Sixteen trainees from Peru, Costa Rica, the Dominican Republic, Panama, Ecuador, Jamaica, Bangladesh, Nepal, and Sri Lanka will each receive six weeks of training at the AISC Models Branch in Columbia, Missouri and the AISC Climate Assessment Branch in Washington, D.C.. Training has been provided in Southeast Asia already to representatives of nine countries, and a similar program is being planned in Sahelian Africa.

VIII. LIST OF ABBREVIATIONS

ACDPP	Advisory Committee on Data Problems and Publications (COSPAR)
AID	Agency for International Development
AISC	Assessment and Information Services Center (NESDIS)
AMSU	Advanced Microwave Sounding Unit
APT	Automatic Picture Transmission
ASFA	Aquatic Sciences and Fisheries Abstracts (ASFIS)
ASFIS	Aquatic Sciences and Fisheries Information System (FAO/IOC/UNOETB)
AVHRR	Advanced Very High Resolution Radiometer
BAPMoN	Background Air Pollution Monitoring Network (WMO)
CAS	Commission for Atmospheric Sciences (WMO)
CCl	Commission for Climatology (WMO)
CICAR	Cooperative Investigation of the Caribbean and Adjacent Regions
CGMS	Coordination on Geostationary Meteorological Satellites
CLOS	Coordination of Land Observing Satellites
CMM	Commission for Marine Meteorology (WMO)
CNES	Centre National d'Etudes Spatiales
CODATA	Committee on Data for Science and Technology (ISCU)
COPUOS	Committee on the Peaceful Uses of Outer Space (U.N.)
CORSS	Coordination of Ocean Remote Se[illegible]atellites
COSPAR	Committee on Space Research (ISC[illegible]
DCP	Data Collection Platform
DNP	Declared National Program
DSB	Direct Sounder Broadcast

ESA	European Space Agency
ESCAP	Economic and Social Council for Asia and the Pacific
FAGS	Federation on Astronomical and Geophysical Services (ICSU)
FAO	Food and Agriculture Organization (United Nations)
FGGE	First GARP Global Experiment (WMO/ICSU)
FOY	FGGE Operational Year (WMO/ICSU)
GARP	Global Atmospheric Research Programme (WMO/ICSU)
GDPS	Global Data-Processing System (WWW)
GOCDB	Global Ocean Climate Data Base
GODI	Global Ocean Data Inventory
GOES	Geostationary Operational Environmental Satellite
GOS	Global Observing System (WWW)
GTS	Global Telecommunication System (WWW)
HRPT	High Resolution Picture Transmission
IAGA	International Association of Geomagnetism and Aeronomy (ICSU)
IAMAP	International Association of Meteorology and Atmospheric Physics
IASPEI	International Association of Seismology and Physics of the Earth's Interior (ICSU)
ICES	International Council for the Exploration of the Seas
ICSU	International Council of Scientific Unions
IEOSC	International Earth Observation Satellite Committee
IGOSS	Integrated Global Ocean Station System (IOC/WMO)
IGY	International Geophysical Year
IMS	International Magnetospheric Study (SCOSTEP)
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCARIBE	IOC Association for the Caribbean Sea and Adjacent Regions

IODE	International Oceanographic Data Exchange (IOC)
IPOMS	International Polar-Orbiting Meteorological Satellite Group
ISCCP	International Satellite Cloud Climatology Project (WMO/IAMAP/COSPAR)
IUGG	International Union of Geodesy and Geophysics (ICSU)
LUT	Local User Terminal
MAP	Middle Atmosphere Program (SCOSTEP)
MARPOLMON-P	Marine Pollution Monitoring Program, Petroleum
MCC	Mission Control Center
MOA	Memorandum of Agreement
MONSEE	Monitoring the Sun-Earth Environment (SCOSTEP)
MOU	Memorandum of Understanding
NCDC	National Climatic Data Center (NOAA/NESDIS)
NESDIS	National Environmental Satellite, Data, and Information Service (NOAA)
NGDC	National Geophysical Data Center (NOAA/NESDIS)
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center (NOAA/NESDIS)
NOP	National Oceanic Program
OFDA	Office of Foreign Disaster Assistance (AID)
ORA	Office of Research and Applications (NESDIS)
OSDPD	Office of Satellite Data Processing and Distribution (NOAA/NESDIS)
ORSTOM	Office de la Recheres Scientifique et Technique Outre-Mer
PAIGH	Pan American Institute of Geography and History
PSFG	Permanent Service on the Fluctuation of Glaciers (FAGS)
RNODC	Responsible National Oceanographic Data Center
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite System

SBUV	Stratospheric Backscattered Ultra-Violet Instrument
SCOSTEP	Scientific Committee on Solar-Terrestrial Physics (ICSU)
SST	Sea Surface Temperature
SSU	Stratospheric Sounding Unit
TEMA	Task Team on Training, Education, and Mutual Assistance in the Marine Sciences (IODE)
TOVS	TIROS Operational Vertical Sounder
UJNR	United States/Japan Cooperative Program in Natural Resources
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNOETB	United Nations Ocean Economics and Technology Branch
VISSR	Visible and Infra-red Spin-Scan Radiometer
WCP	World Climate Programme (WMO)
WCRP	World Climate Research Programme (WMO)
WDC	World Data Center
WEFAX	Weather Facsimile
WMO	World Meteorological Organization
WWW	World Weather Watch (WMO)

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APPENDIX III

NATIONAL RESEARCH COUNCIL
COMMISSION ON ENGINEERING AND TECHNICAL SYSTEMS
2101 Constitution Avenue Washington, D.C. 20418

SPACE APPLICATIONS BOARD
(202) 334-3272

July 17, 1984

Honorable Harold L. Volkmer
Chairman, Subcommittee on Space Science
and Applications
Committee on Science and Technology
U.S. House of Representatives
Suite 2321, Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Volkmer:

Mr. George A. Harter, Chairman of the Space Applications Board, has asked me to respond to your letter of July 2, 1984 in which you invite the Board to submit a written statement for incorporation in the record of the Subcommittee's hearing on International Cooperation and Competition in Space.

At its meeting of May 15-16, 1984, the Space Applications Board reviewed the House Bill on transfer of land remote sensing to the private sector (H.R. 5155) and drew several conclusions with respect to the bill. One of these concerns possible foreign competition. The Bill provides that land remote sensing data shall be made available to all potential users on a non-discriminatory basis, and also that U.S. operating companies must be licensed by the Secretary of Commerce. This implies that U.S. companies must provide data on a non-discriminatory basis. It does not appear that foreign companies, operating outside the United States but marketing data inside the U.S., are similarly bound.

Our Board feels that this situation can result in unfair foreign competition with U.S. companies attempting to provide land remote sensing data in accordance with the provisions of the bill. At its meeting in May, the Board concluded that something should be done to rectify this situation in a manner that will alleviate the potential advantage accruing to foreign operators.

Your letter also asks us to comment on a draft report of the Office of Technology Assessment entitled "International Cooperation and Competition in Civilian Space Activities." We have just recently received a preliminary draft of this report but have not had time to study it in detail. The report does not deal with the point we have made in this letter on unfair foreign competition. However, the report appears to be a comprehensive and well-constructed document and should provide a valuable background of information for the committee.

We hope you will find our comments helpful.

Sincerely,
Milton W. Rosen

Milton W. Rosen
Executive Director
Space Applications Board

APPENDIX IV

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J.H. POORE
Executive Director
ROBERT C. KETCHAM
General Counsel
DAVID S. JEFFERY
Minority Staff Director

August 9, 1984

Mr. George Harter, Chairman
Space Applications Board, JH-419
2101 Constitution Avenue, NW
Washington, DC 20418

Dear Mr. Harter:

Thank you for the letter from Mr. Rosen with your comments concerning the impact of H.R. 5155 on international cooperation and competition.

Your point that the insistence on non-discriminatory data access embodied in H.R. 5155 may have adverse impacts on U.S. operators is a good one and we did consider it.

However, we also considered two other points which together with others led us to retain the non-discriminatory policy. First, we believe that value-added products derived from the raw data are what most need proprietary protection, and our bill allows for that. In fact, we encourage a strong value-added industry as necessary to market development. Second, we believe than an unambiguous U.S. statement that we intend to maintain a non-discriminatory policy will both convice other provider nations to do the same and also encourage data customers to believe that they will continue to be treated fairly by the U.S. In other words, our policy may be neutral or even favorable to U.S. system operators.

Nevertheless, we value your input and recognize that you have raised a serious concern. Accordingly, we solicit your assistance in determining how this policy is working over the next few years. If necessary, we can modify the legislation, but of course we would not do so lightly.

Again, thank you for your help.

Sincerely,

Harold L Volkmer

HAROLD L. VOLKMER, Chairman
Subcommittee on Space Science
and Applications

HLV:RS/ld

APPENDIX V

NATIONAL RESEARCH COUNCIL
COMMISSION ON ENGINEERING AND TECHNICAL SYSTEMS
2101 Constitution Avenue Washington, D.C. 20418

SPACE APPLICATIONS BOARD (202) 334-3272

September 14, 1984

The Honorable Harold L. Volkmer
Chairman, Subcommittee on Space Science
and Applications
Committee on Science and Technology
U.S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman:

Your letter of August 9, 1984 responds to ours of July 17, 1984, which submits on behalf of the Space Applications Board, a written statement for the record of the Subcommittee's hearing on international cooperation and competition in space.

Our Chairman, Mr. George A. Harter, is concerned that there may be some misunderstanding about our statement and has instructed me to clarify it as follows.

Our statement contends that unfair foreign competition with U.S. companies, attempting to provide land remote sensing data in accordance with the provisions of H.R. 5155 (now public law 98-365), might occur because foreign companies are not bound by the non-discriminatory access provisions of the law.

Actually, the Space Applications Board is in favor of the non-discriminatory access provisions of PL 98-365, but does not see how they can be made applicable to foreign companies marketing data inside the U.S. It is this situation that we consider unfair and that we believe should be corrected.

Sincerely,

Milton W. Rosen
Executive Director

MR/vm

The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering to serve government and other organizations